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Assessment of Soil Aggregates and Erodibility Under Different Management Practices in the Mountainous Soils

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ABSTRACT

Soil erosion in the hilly and mountainous uplands in the Daekwanryong area, Kangwon-Do, were investigated through a field plot experiment. The plot size was 15m long and 2.5m wide with the average slope of 12.5 percents. Soil erodibility factor (K), surface coverage (SC), soil aggregate percentage and wind erodibility (I) were evaluated in the mountainous soils under different management practices for corn and potato cultivations. Soil erodibility factor (K) was greater in upper part than in lower part of the plots. Surface coverage (SC) values ranged from 0.01 to 0.84 depending on the amounts of crop residues. Soils having a greater crop residue in surface were less subjected to soil erosion. SC values after corn harvest were 0.4 to 0.8, while those after potato harvest were 0.4 to 0.5, indicating potato might be better than corn for erosion control. Soil aggregate percentages of the experimental plots ranged from 49.7 to 79.8%. Those were higher in potato-cultivated plots with higher surface coverage, organic fertilizer treatment and contour tillage. Soil aggregate percentage of potato-cultivated plots was significantly correlated to crop residue coverage after harvest. The dried soil aggregate percentage, showing the ranges of 26.4 to 56.4%, were higher in the plots with the increased crop residue incorporation. Wind erodibility (I) of the soil was decreased with increasing surface coverage. When soil had 26.4% of the dried aggregate percentage, wind erodibility was estimated to be 183 Mg ha^{-1} which was equivalent to soil loss of 0.5 Mg ha^{-1} day^{-1}.

Key words : Surface coverage, Soil aggregate, Soil erodibility, Soil erosion, Wind erodibility.

Introduction

Soil erosion has been a major issue in environmental agriculture in Korea to conserve soil and soil productivity in the sloped land. The vegetable and potato cultivations in the alpine area of the Kangwon-Do have been widespread since 1960' s. Continuous cropping, however, has lead severe loss of fertile surface soil in this area. Jung et al. (1999a) calculated amount of upland soil loss in Kangwon-Do using Universal Soil Loss Equation, USLE, and pointed that 144 Mg surface soil per ha might be eroded from bare fallow without any proper management practices. If bulk density of soil is 1.3 M gm^{-3}, this soil loss is equivalent to 11 mm of soil surface. Since 46.2 percents of the soils under vegetable cultivation in the alpine area in Kangwon-Do were on the 15 to 60 percent slope (Cho, 1999), soil erosion protection is

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urgently need.

One of the management practices to reduce soil erosion in severely sloped upland soil is to apply cropping system of low soil erosion, and to maximize the effect of coverage by crop residue, hairy vetch, or wheat (Jung et al., 1983; Jung et al., 1999b). Surface cover reduces soil erosion by water because it absorbs raindrop impact energy, reduces the area of erodible surface causing flow energy to be dissipated on nonerodible cover in contact with the surface, increase infiltration by reducing surface sealing, and slows the velocity of runoff (Box, Jr., 1981). Surface cover includes crop residue, rocks, or other nonerodible material that is in direct contact with the soil surface (Simanton et al., 1984; Box, Jr., 1981). Soil incorporated residues result in favorable infiltration when they maintain favorable soil porosity and organic matter concentration (Unger, 1992). Jung et al. (1999b) reviewed the effect of gravel covering on soil erosion and reported that soil erosion could be reduced a half when gravel content was 40 percents.

To establish the best management practice, BMP, for soil conservation in the hilly soils in Kangwon-Do, corn and potato were cultivated with different fertilizers, crop residues, and tillage treatments in sloped field. Surface cover factor, which is the single most important factor in determining soil erosion, and soil aggregate percentage were investigated.

Materials and Methods

1. Experimental Field

A field experiment was conducted at the Alpine Agricultural Experiment Station, Rural Development Administration located in Pyongchang, Kangwon-Do. The experimental field was located at E37° 40′ 25″ and N128° 45′ 30″ in Neunkyung Mt. (1123 m) of Taebaek Mountains, apart 1.2 km south from Daekwanryong rest area of the Youngdong Highway. Elevation of experimental area was 900 m. The slope of the field was 11.9 to 13.3 percents with average of 12.5 percents. The eleven experimental plots with the width of 2.5m and the length of 15 m were set and divided with 0.7-mm thick tin plates, therefore, the plots were protected from surface or interflow from the outside field.

2. Management Practices

Experimental treatments for cropping system, fertilizer, tillage, and surface coverage were shown in Table 1. Corn and potatoes were cultivated. Kinds of fertilizer application included chemical fertilizer, chemical fertilizer and compost combination, and compost. Tillage methods were contour, no till, and up-down tillage. Surface coverages were no-mulch, 60 and 100 percent straw mulch for corn, and no-mulch and black plastic film mulch for potatoes. Details for the management were listed in elsewhere (Kim, 2000).

Table 1. Field plot treatments under different management practies on crop, fertillizer, tillage and surface coverage

Plot No.	Crop	Fertilizer *	Tillage**	Surface cover
1	Corn	NPK	CT	None
2	Corn	NPK+Compost	CT	None
3	Corn	Compost	CT	None
4	Corn	NPK+Compost	NT	Straw 100%
5	Corn	NPK+Compost	UD	None
6	Corn	NPK	CT	Straw 60%
7	Potato	NPK	CT	None
8	Potato	NPK+Compost	CT	None
9	Potato	Compost	CT	None
10	Potato	NPK+Compost	UD	None
11	Potato	NPK+Compost	CT	Black plastic film

* Commercial chemical and by-product orgnic fertilizer were applied

** CT : contour tillage, NT : no till and UD : up-down tillage

3. Crop Residue Coverage Determination

Crop residue coverage was determined by pin-touch method. Pin touch apparatus was designed with a row of 40 pins equally spaced in 1 meter. The percentage of the pins touched to crop residue on soil surface was regarded as crop residue coverage percentage, CRC.

4. Water Stable Aggregate Distribution Analysis

Undisturbed soil samples for water stable aggregate analysis were taken from the top 10-cm depth, and brought to laboratory for analysis. The soil samples were placed on the plate and pressed lightly by hand to break large blocks. The 30 grams of the soil sample were taken from each plate with four replications. The samples were placed in the Yoder-type aggregate distribution analyzer. Samples were shaken for 30 min and separated by sieve size, 2, 1, 0.5, 0.1 and 0.05mm. Sieved aggregates were dried at 105 ℃ for 24 hrs and weighed. Separately, the 10 grams of the soil samples were treated with 10 ml of dispersion agent, and repeated for same procedure as above. The analysis was replicated four times.

5. Dry Soil Aggregate Analysis

One kg of soil sample from soil surface layer (0 - 2 cm) was taken after harvest. The soil samples were placed on plate and pressed lightly by hand to break large blocks. Samples were weighed, and sieved on 0.84 mm (No. 20) sieve. The amount of sample remaining on the sieve were weighed. Mass fraction of the total sample that was retained on the sieve was calculated, and soil erodibility were determined by the method of Woodruff and Siddoway (1965).

6. Universal Soil Loss Equation (USLE) and Crop Coverage

Soil loss by rainfall was estimated by the USLE (Universal Soil Loss Equation) (Wischmeier and Smith, 1978) (eq. 1)

$$A = R \cdot K \cdot LS \cdot C \cdot P \tag{1}$$

where, A: soil loss per unit area, expressed in units selected for K and for period selected for R (in practice, A is usually expressed in Mg ha^{-1} yr^{-1}), R: rainfall factor (EI_{30}), LS: slope length and slope gradient factor, C: cover and management factor, and P: supporting practice factor. The soil loss ratios (SLR) used to calculate C factor are probably the most important term in USLE, because they represent conditions that can be managed most easily to reduce soil erosion. Furthermore, values of C can vary from near 0 for a very well covered soil to approximately 1.5 for a finely tilled, ridge surface that results in much runoff and leaves soil susceptible to rill erosion. McCool et al. (1987) suggested surface residue was more important under winter runoff erosion conditions than in regions which have higher intensity summer storms through 9 yr data. They also reported that 1,100 kg/ha of surface residue reduced soil loss to as little as 8% of the soil loss in which there was no surface residue.

In revised-USLE (RUSLE) (Renard et al., 1997), SLR (soil loss ratio) is used to calculate cover management factor (C). SLR is the loss from a given treatment relative to soil loss from an area in continuously tilled fallow (eq. 2). The SLR can range from near 0 to 1.0.

$$SLR = PLU \cdot CC \cdot SC \cdot SR \cdot SM \tag{2}$$

where, PLU is prior land use, CC is canopy cover, SC is surface cover, SR is surface roughness, and SM is prior soil moisture.

The surface cover cover (SC) was calculated as following equation (3):

$$SC = SLR/(PLU \times CC \times SR \times SM) \tag{3}$$

In RUSLE model, the effect of surface residue cover vary for the interrill, mixed and interrill, and rill erosion. Surface residue cover affected much greatly for the rill erosion than for the interrill erosion. When SC values are plotted vs. residue cover (%), exponential relationship has been regarded as best fit for SC and residue cover (%) (McCool, 1997). Surface coverage values for potato or corn cultivated plots were compared. The relationship for SC and residue cover (%) is given by the following equation (4) and shown in Fig. 1.

$$SC = \exp(-bM) \qquad (4)$$

where, SC: surface cover, b: coefficient, and M: percentage surface cover. b value was 0.045, and r^2 was 0.99.

7. Soil Wind Erodibility (I) and Ridge Roughness

Soil aggregate is a primary variable affecting wind erosion. Soil wind erodibility was determined based on the method by Chepil and Milne (1941). Chepil (1950) determined relative erodibilities of soils in the absence of organic residues as a function of specific gravity and proportions of dry soil aggregates in various sizes from wind tunnel tests. Clods larger than 0.84 mm in diameter were nonerodible to wind speed used in the tests, thus, nonerodible soil fraction > 0.84 has been used to indicate erodibility of soil by wind. Wind erodibility index (I) was based on the non-erodible fraction. Using wind erodibility index (I), annual soil loss was predicted from table by Woodruff and Siddoway (1965).

Ridge roughness was estimated following the Williams and Berndt method (1977) which fitted equations to the curve of Woodruff and Siddiway (1965) to express the ridge-roughness factor as following equations (5~7):

$$K = 1.0, \text{ if } HR^2/IR < 0.57 \qquad (5)$$

$$K = 0.913 - 0.153\ln(HR^2/IR), \text{ if } 0.57 < (HR^2/IR) < 22.3 \qquad (6)$$

$$K = 0.336\exp(0.013HR^2/IR), \text{ if } (HR^2/IR) \geq 22.3 \qquad (7)$$

where, HR and IR are ridge height and ridge spacing, respectively, in mm. A field with ridges 100 mm high and spaced 400 mm apart has HR2/IR = 25. Because 25 > 22.3 and using equation (7), the ridge roughness factor K = 0.5.

Results and Discussions

1. Soil Erodibility Factor (K) for the Field Plot

Soil erodibility factor (K) for corn, determined by Wischmeier's monograph (Wischmeier and Smith, 1978), was 0.17 with the range from 0.15 to 0.20, and that for potatoes was 0.19 (Table 2). The K-values in the upper parts of the plots were higher than the lower parts of the plots. K-values for the upper and lower corn plots were 0.18 (0.15 - 0.20), and 0.16 (0.15 - 0.18), respectively. For the upper and lower potato plots, averaged K-value was 0.19 (0.17 - 0.22), and 0.18 (0.17 - 0.20), respectively. Slope degree of experimental field was 12.5 percents in average and the field length was 15m, therefore, slope length and gradient factor (LS) was 1.64.

Table 3 shows the estimated maximum soil loss (Amax, ton/ha^{-1}). The 75 Mg ha^{-1} of surface soil in this area could be eroded from the bare-fallow field {cover and management factor (C) × supporting practice factor (P) = 1)} without proper management practices. Jung et al. (1999a) reported that, when corn was monocultured with contoured tillage, C

Table 2. Soil erodibility factor (K) under different management practies at the experimental plots

Crop	Plot No.	Management practices			K values	
		Fertilizer	Tillage	Surface cover	Upper plot	Lower plot
Corn	1	NPK	CT	None	0.18	0.15
	2	NPK+Compost	CT	None	0.20	0.15
	3	Compost	CT	None	0.20	0.15
	4	NPK+Compost	NT	100%	0.19	0.17
	5	NPK+Compost	UD	None	0.16	0.16
	6	NPK	CT	60%	0.15	0.18
Potato	7	NPK	CT	None	0.18	0.17
	8	NPK+Compost	CT	None	0.20	0.17
	9	Compost	CT	None	0.17	0.18
	10	NPK+Compost	UD	None	0.22	0.18
	11	NPK+Compost	CT	Black plastic film	0.20	0.20

Table 3. The estimated maximum soil loss (A_{max}, Mg ha^{-1}) under the field plot conditions

Factor	Rainfall factor (R : EI_{30})	Soil erodibility factor (K)	Slope-length and slope-gradient factor(LS)	Maximum soil loss (A_{max}, Mg ha^{-1})
Value	268	0.17	1.64	74.7

value was 0.4, and P value was 0.6, respectively, resulting in soil loss (A) = Amax × 0.4 × 0.6 = 34.5 Mg ha^{-1} yr^{-1}. They suggested that C × P value should be reduced below 0.37 to maintain less than 1 mm soil surface erosion a year. They also suggested that one of the various strategies to reduce C × P value is to employ the effective cropping system which covers the soil surface by crop residues.

2. Surface Cover Factor (SC) for the Experimental Field

Table 4 shows CRC (%) and SC values for potato and corn with different treatments. After harvest, SC values for the corn plots excluding mulched plots ranged from 0.43 to 0.95, while SC values for potato plots ranged from 0.39 - 0.54. This indicated that much greater residues of potato remained on surface than corn residue, resulting in less soil erosion for potato plot. As shown in Table 4 and Fig. 1, SC value was 0.84 and 0.01 for the plot with lowest CRC (%) and plot with 100% CRC, respectively, which could result in great difference for soil erosion. The b value (eq. 4) indicates the effect of surface cover in reducing soil erosion. Laflen et al. (1989) found b values of 0.030 to 0.070 for row crops, while b values of 0.024 to 0.032 for small grains.

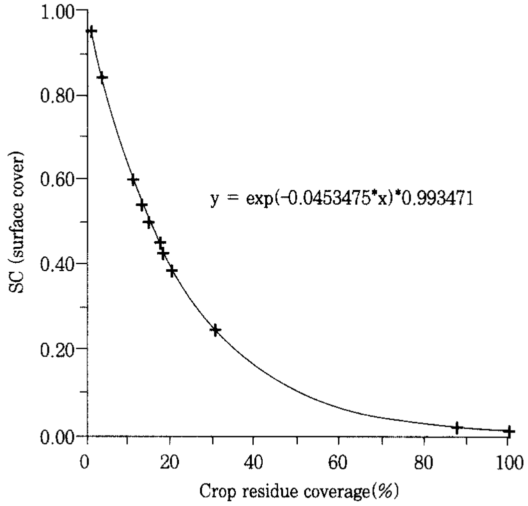

Fig. 1. Exponential relationship between surface cover and crop residue coverage(%).

Table 4. Crop residue coverage(%) and organic matter content in soil surface (25mm depth) after harvesting corn and potato

Crop	Plot No.	TOM(0~25mm) (g kg^{-1})*	Soil organic matter contents(g kg^{-1})	Crop residue (g kg^{-1})	CRC (%) **	SC
Corn	1	63.4	41.8	21.6	11.0	0.60
	2	62.3	39.3	23.0	18.3	0.43
	3	55.0	34.9	20.1	3.7	0.84
	4	177.9	25.7	152.2	100.0	0.01
	5	48.5	25.2	23.2	1.2	0.95
	6	70.1	24.6	45.5	87.8	0.02
Potato	7	101.2	41.8	59.4	17.5	0.45
	8	134.0	41.7	92.3	20.5	0.39
	9	110.6	40.1	70.5	15.0	0.50
	10	116.5	34.3	82.2	13.4	0.54
	11	133.5	35.0	98.5	30.5	0.25

* TOM : total organic matter contents in surface soils determined by loss on ignition at 360℃, after drying soil at 105℃ (Schulte and Hopkins, 1996)

** Crop residue coverage(%) : determined by pin-touch method

3. Soil Aggregate Percentage

Table 5 shows soil aggregate percentage of the experimental plots with different treatments. The aggregate percentage ranged from 49.7 - 79.8 percents. The aggregate percentage was the lowest in the plot No. 5 (corn, NPK + compost combination, and up-down till practice). In contrast, aggregate percentage was relatively higher (76.44 - 79.79 %) for the plot No. 11 (potato, NPK + compost combination, and black plastic-film mulching), plot No. 2 (corn, NPK + compost combination, and contour), and plot No. 9 (potato, compost, and contour tillage) than others. According to Baver (1966), soil structure is closely related to soil fertility, therefore, infiltration and aeration of soil are much better for the well-aggregated soil than poorly-aggregated soil. For the sloped soil, soil physical characteristics, soil conservation, and reduction of soil erosion could be improved by cultivating crops which leave much residues and great surface coverage with contoured tillage.

Fig. 2 shows relationship between crop residue coverage (CRC: %) and the water stable soil aggregate percentage, SA, in the corn plots except the mulched plots ($SA = 1.59*CRC + 49$; $r^2 = 0.96$). As crop residue coverage increased, soil aggregate percentage increased. Aggregate percentages of the mulched corn plot and non-mulched corn plot were 63.5, and 61.0%, respectively, which indicated slightly greater aggregate percentage in the mulched corn plot. CRC after potato harvest ranged from 13- 20 percents, showing no significant difference among treatments. Aggregate percentage as a function of CRC (%) was $SA = -1.12*CRC + 32$ ($r^2 = 0.33$), which was not significantly related.

Fig. 3 and 4 show aggregate percentages under the different fertilizer application and tillage in experimental field. The aggregate percentage for the corn cultivated plot was the highest in the plot treated with NPK + compost + contour tillage (C + O, CT), while lowest in the plot under NPK + compost + up-down tillage (C + O, UD) (Fig. 3). Aggregate percentage (%) for the potato cultivated plot was highest in the plot treated with compost and contour tillage (O, CT), while lowest in the plot under NPK + compost and contour tillage (C + O, CT) (Fig. 4). Averaged aggregate

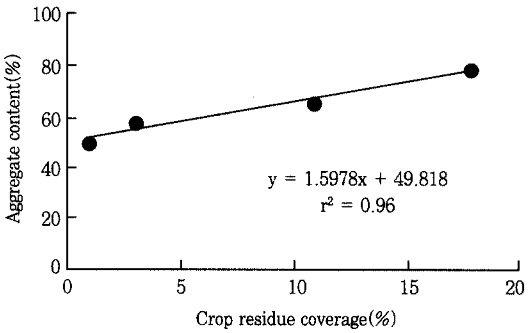

Fig. 2. Relationship between aggregate percentages and crop residue coverage(%) by the crop residue.

Table 5. Size distribution of water stable aggregates of the soils taken at the experimental plots

Plot No.	〉2.0mm	1.0mm ~ 2.0mm	0.5mm ~ 1.0mm	0.25mm ~ 0.5mm	0.1mm ~ 0.25mm	Total
			%			
1	9.12	16.32	21.72	15.83	3.08	66.07
2	11.19	22.74	26.77	14.16	4.94	79.79
3	7.80	12.56	18.55	14.39	5.08	58.36
4	25.13	13.67	14.99	7.32	1.49	62.59
5	6.93	12.42	15.71	10.17	4.49	49.72
6	9.57	13.91	16.61	11.85	8.39	60.32
7	7.61	12.65	23.69	19.03	4.59	67.57
8	3.58	10.13	18.42	16.13	5.35	53.60
9	7.56	17.54	28.02	20.80	5.53	79.44
10	8.16	17.45	22.44	12.57	3.67	64.28
11	6.09	20.05	29.52	16.99	3.81	76.44

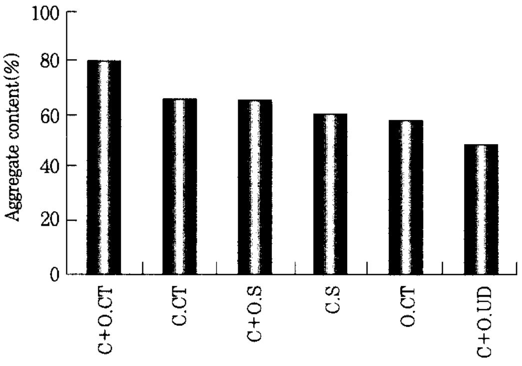

Fig. 3. Comparison of aggregate percentage under different management practices in corn plots. Treatment abbreviations are as follows.

C+O, CT : NPK+compost, contour tillage
C, CT : NPK, contour tillage
C+O, S : NPK+compost, surface cover
C, S : NPK , surface cover
O, CT : compost, contour tillage
C+O, UD : NPK+compost, up-down tillage

percentage (%) of potato cultivated plot was higher (68.27%) than that (62.81%) of corn cultivated plot.

4. Soil Wind Erodibility (I)

Chepil and Milne (1941) studied the influence of surface roughness on intensity of drifting dune materials and cultivated soils. They found that the initial intensity of drifting was always much less over a ridged surface. Ridging cultivated soil reduced the severity of drifting, but ridging highly edodible dune material was less effective because ridges disappeared rapidly. The rate of flow varied inversely with surface roughness. Armbrust et al. (1964) reported that ridge roughness estimates the fractional reduction of erosion caused by ridges of nonerodible aggregates. It is influenced by ridge spacing and ridge height and is defined relative to 1:4 ridge height to ridge spacing ratio. Hayes (1965) suggested evaluating fields as either smooth, semiridged, or ridged and then assigning 1.0, 0.75, and 0.50, respectively, as soil ridge roughness factors.

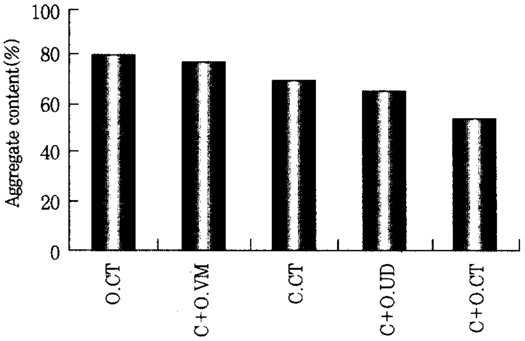

Fig. 4. Comparison of aggregate percentage under different management practices in potato plots. Treatment abbreviations are as follows.

O, CT : compost, contour tillage
CC+O, VM : NPK+compost, vinyl mulching
C, CT : NPK, fertilizer, contour tillage
C+O, UD : NPK+compost, up-down tillage
C+O, CT : NPK+compost, contour tillage

Dry soil aggregate percentage by size distribution collected

Table 6. Size distribution of the dried aggregates of the soils taken at the experimental plots

Plot No.	Dry aggregate percentage						
	〉2.0mm	1.0mm ~ 2.0mm	0.5mm ~ 1.0mm	0.25mm ~ 0.5mm	0.1mm ~ 0.25mm	0.05mm ~ 0.1mm	〈 0.05mm
1	7.62	11.80	21.85	22.99	25.97	4.70	5.06
2	6.89	12.00	23.41	21.33	27.70	3.88	4.80
3	14.08	9.73	16.98	16.61	22.83	10.04	9.73
4	19.36	11.16	21.39	20.35	17.63	5.73	4.38
5	20.81	11.78	17.13	16.60	17.87	10.08	5.73
6	36.47	14.75	16.34	12.69	12.17	4.69	2.89
7	13.11	10.43	19.61	18.87	21.62	13.08	3.28
8	12.34	12.95	21.87	18.83	19.70	9.15	5.16
9	11.40	14.78	23.74	19.07	18.74	7.57	4.71
10	13.33	15.12	22.14	19.74	18.46	7.96	3.25
11	9.15	13.38	23.91	21.09	19.54	9.74	3.20

Table 7. Non erodible dry aggregate percentage, soil erodibility (I), and surface roughness(K-) under various treatments of the experimental plots

Crop	Treatment			D.A*	I	K	
	Fertilizer	Tillage	Coverage	(%)	(Mg ha^{-1})	AS**	AH ***
Corn	NPK	CT	None	26.42	183.04	0.52	0.83
	NPK+Compost	CT	None	26.38	183.32	0.53	0.86
	Compost	CT	None	29.24	168.60	0.64	0.60
	NPK+Compost	NT	100%	37.36	137.66	0.54	0.66
	NPK+Compost	UD	None	38.07	133.75	0.62	0.90
	NPK	CT	60%	56.45	57.54	0.49	0.70
Potato	NPK	CT	None	29.81	165.38	0.62	0.52
	NPK+Compost	CT	None	32.29	157.57	0.58	0.84
	Compost	CT	None	33.78	151.42	0.65	0.67
	NPK+Compost	UD	None	35.54	143.78	0.64	0.80
	NPK+Compost	CT	Black plastic film	30.17	165.06	0.49	0.64

* Non-erodible dry aggregate percentage (D.A., %)

** After seeding (AS)

*** After harvest (AH)

at the experimental field are shown in Table 6. For the corn plot, aggregate percentages greater than 1.00 mm were different between mulched (40.87%) and non-mulched (23.67%) plots. According to Yoo et al. (1974), aggregate size for optimum crop growth ranges from 1.00 to 3.00 mm.

Table 7 shows surface roughness (K′) estimated as a function of non-erodible dry aggregate percentage, soil wind erodibility (I), and field surface roughness. The non-erodible dry soil aggregate percentages ranged from 26.4 to 56.5%. For the plot No. 1, dry soil aggregate percentages was 26.42%, soil wind erodibility (I) was 183.04 Mg ha^{-1}, and surface roughness (K′) was 0.52. This implies that, in dry condition which wind erosion could occur, estimated amount of wind erosion was 0.5 Mg ha^{-1} day^{-1}. Due to intensive rainfall in summer, soil wind erodibility (I) was relatively lower, while, in winter, soil surface remains dried for a longer period resulting in higher soil wind erodibility (I) and increased erosion. Surface roughness (K′) for the corn cultivated plot ranged from 0.49 - 0.64 after planting, while they increased (0.60 - 0.90) after harvest. Surface roughness (K′) for the potato cultivated plot ranged from 0.49 - 0.65 after planting, while they increased (0.52 - 0.84) after harvest.

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Assessment of Soil Aggregates and Erodibility Under Different Management Practices in the Mountainous Soils

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산지에서 영농방법에 따른 토양입단과 침식성 평가

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강원도 평창군 도암면에 소재하는 농촌진흥청 고령지 농업 시험장에 포장을 설치하여 옥수수와 감자 작부 체계 하에 토양의 토양피복인자 (SC), 내수성 토양 입단함량, 내풍식성 입단함량과 풍식성 인자 (I)를 조사하였다. 토양 침식인자 값 (K)은 실험 처리구의 상부가 하부보다 높았다. SC 값은 식물 잔재물의 양에 따라 다른 값을 보였으며, 0.01~0.84 이었다. 수확 후 식물 잔재물의 지면 피복도 (%)에 따른 SC 부요소 값은 옥수수 재배구에서 0.4~0.8 이며, 감자 재배구에서는 0.4~0.5이었다. 이는 감자 수확 시 잔재물이 옥수수 수확 시 잔재물에 비해 비교적 많이 남기 때문이었다. 시험 포지 토양의 입단함량 범위는 49.7~79.8%이었다. 옥수수 재배구 중 화학비료 및 유기질 비료를 시용하고 등고선 경운 방법에 의한 처리구가 입단함량이 가장 높았다. 옥수수 수확 후의 피복도 (%)와 입단 함량 (%)의 관계는 회귀관계식이 성립되며, r^2는 0.96 이었다. 옥수수 재배구의 평균 입단함량이 감자 재배 포장의 평균 입단함량보다 다소 낮았다. 시험 포지 토양의 내풍식성 입단함량의 범위는 26.38~56.45% 이었다. 옥수수 재배구의 토양 입단 함량 (%)은 수확 후 잔재물과 유의성이 있었다. 옥수수 재배구 중 화학비료 및 유기질 비료를 시용하고 등고선 경운법에 의한 처리구의 경우 내풍식성 입단 함량은 26.42%로 풍식성 인자를 계산하면 183 Mg ha^{-1} 이고, 토양의 휴조도 인자 (K′)는 0.52이었다. 이에 따르면, 년 중 기상상태가 풍식이 일어날 수 있는 건조 상태일 경우 최대 풍식 가능량은 1일 0.5 Mg ha^{-1}에 해당하는 양이었다.

Key words : Surface coverage, Soil aggregate, Soil erodibility, Soil erosion, Wind erodibility.

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