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Impact of Cover Crops on Reducing the Potential Erosion in Agricultural Land

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Abstract - A study about the utilization of cover crops on reducing the potential erosion in agricultural land was conducted from October 2016 to Februari 2017. This study was aimed (1) to examine the effect of vetiver (*Vetiveria zizanioides*), king grass (*Pennisetum purpuroides*), elephant grass (*Pennisetum purpureum*), and tree marigold (*Tithonia diversivolia*) cultivation on soil physical properties and reducing erosion rate, and (2) to identified the root development stage of *Vetiveria zizanioides* with different age affect the root system. The experiment was designed with a completely randomized layout with three replications using five treatments. The soil physical characteristics and plant data were statistically analyzed with analysis of variance (ANOVA) and followed by Tukey`s test. The results showed that there was no significant effect from the cultivation of cover crops to soil physical characteristics. However, the cultivation of cover crops to the soil was effective to decrease the rate of run off and reduced the potential erosion. The experiment revealed that the elephant grass has significant effect in decreasing rate of run off and amount of soil loss.

***Keywords* - Erosion, Landslides, Cover Crops, Vetiver (*Vetiveria Zizanioides*), King Grass (*Pennisetum Purpuroides*), Tree Marigold (*Tithonia Diversifolia*), Elephant Grass (*Penisetum Purpureum*).**

I. INTRODUCTION

Landslides are an ordinary natural phenomenon in the history of the earth. Landslides are more interpreted as the displacement of large volumes of soil, landslides are basically a form of erosion which transports or removes rock masses at some time in large volumes related to designation and trees, in rapid and flexible time [(1)].

The physical properties of soil are one of the factors that determine soil resistancy to erosion, surface flow and landslides. Soil resistance to erosion and landslides are different and are determined by soil physical properties such as soil texture, soil structure, organic matter content, soil permeability, and land use practices[(2)]. Sandy soils are more sensitive to landslides than silty soils. Sandy soils have a high infiltration capacity, but low stability of structur because the space between particles do not have a large binding capacity[(3)]. One of the former landslide areas that need attention is the Nagari Tandikek Patamuan District, Padang Pariaman Regency which is a hilly and mountainous area with an area of ± 53.83 km2 and has a height of 25-500 m d.p.l. especially in Koto Mambang. Patamuan sub-district had a landslide on 30 September 2009. The landslide disaster killed thousands of people and caused irrigation facilities and infrastructure to experience paralysis. Based on the results of Loannisa [(4)] research that in the are of Koto Mambang belongs to the level of severe landslide hazard. Therefore, landslides that have occurred in this area are one of the natural disasters that must be minimized.

Erosion and landslides can be prevented or overcome by applying vegetative soil conservation techniques or plants in the form of tree or shrub management, both perennials and annual crops and grasses through the selection of plant species and plant density settings[(5)]. Truong [(6)] states that handling erosion and landslides by utilizing plants has several advantages, including having low costs, being able to provide nutrients for plants and having a function as a cover crop. Vetiver grass (Vetiveria zizanioides), king grass (Pennisetum purpuroides), elephant grass (Pennisetum purpureum) and titonia (Tithonia diversivolia) are plants that can be used in the application of vegetative soil

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conservation techniques. Planting these four types of grass has a great opportunity to be adopted by farmers, especially in the Koto Mambang Nagari Tandikek area, Patamuan District. Reported by Rachman et al., [7] the type of grass has a function in reducing runoff and erosion.

Vetiver grass (Vetiveria zizanioides) is a kind of large herbaceous tropical plant that has many features, between vetiver grass roots able to hold soil particles and maintain soil stability against changes in water content, so that the roots will later prevent erosion and landslides. Furthermore, Maridi [8] added that the plant root system greatly affects erosion because the plant root system determines plant activity in helping the formation and stabilization of soil aggregates. Other types of cover crops that can be utilized are king grass (Pennisetum purpuroides), elephant grass (Pennisetum purpureum) and tithonia (Tithonia diversivolia), where the roots of king grass (Pennisetum purpuroides) and elephant grass (Pennisetum purpureum) also have the ability to maintain stability soil to changes in water content, so as to minimize surface flow and erosion. While the advantages of titonia (Tithonia diversivolia) are able to grow quickly and in a short time can form a thick bush and titonia also has density in the roots and leaves.

II. Materials And Method

The study was carried out from October 2016 to Februari 2017 in the greenhouse of Faculty of Agriculture, Andalas University Padang. The plant root observation vetiver (*Vetiveria zizanioides*) yang was conducted in 2015 Nagari Tandikek Kecamatan Patamuan Kabupaten Padang Pariaman.

This experiment was designed with a completely radomized layout with tree replications and consist of five treatments:

A = control (without cover crops)
B = cultivated with vetiver (*Vetiveria zizanioides*)
C = cultivated with king grass (*Pennisetum purpuroides)*
D = cultivated with tree marigold (*Tithonia diversifolia*)
E = cultivated with elephant grass (*Pennisetum purpureum*)
The landslides soil was collected from Patamuan Sub-district and was used as a culture soil in the erosion plot 1,5 m x 0,5 m x 0,3 m (Fig. 1).

Root development system was observed of each cover crops to determine the relationship of the presence of cover crop and soil properties. Plant height and number of leaves were also recorded once a month for three months and by the end of the experiment one of each cover crop from each treatment was collected to determine the root development system.

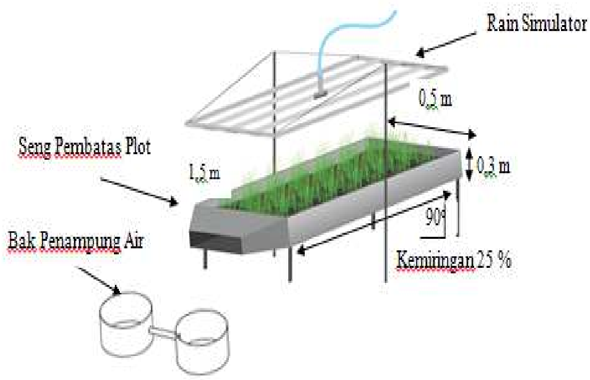

Figure 1. Erosion Plot Design

III. Results And Discussion

1.1 Soil Physical Properties before the treatment

Soil properties that affect erosion are texture, structure, organic matter and BV soil. Soil texture is one of the characteristics of soil physical properties that play a role in the process of erosion and landslides. Soil texture will affect the ability of the soil to store and deliver water. The soil texture in this study area is dominated by sand 50% - 60%[4]. The soil in this study was classified as sandy clay class. The results of the analysis of the initial soil physical properties are presented in Table 1.

Table 1. Soil physical properties before treatment

Soil Parameter	0-20 cm Soil Depth
Texture	Sandy Loam
Structure	Granular, medium-coarse
Organic matter (%)	0,62 $_{(r)}$
BD (g/cm³)	0,65$_{(r)}$
Porosity (%)	74,32$_{(r)}$
Permeability (cm/hour)	46,04$_{(sc)}$
Agregat stability	58 % $_{(tm)}$

Note : r = low, sc = very fast, tm = not compact

Soils with a texture dominated by sand have less strong aggregate strength. If there is a lot of ground water, it can cause the aggregate to become unstable and if the groundwater conditions are small, then the soil aggregates will be more stable. The presence of soil with a clay texture, if in a humid state it is difficult to dry, this condition causes the volume of soil to increase which greatly supports erosion and landslides. According to Kartasapoetra [(3)] land dominated by sand is more resistant to erosion compared to dust soils, because sand soil has a high infiltration capacity. In addition, sand with a larger size will be easier to drift and the stability of the structure is low because between particles with one another do not have a large binding capacity.

The characteristics of soil physical properties that play a role in the process of erosion and landslides are soil structures. The soil structure in this study was granular, medium. According to Andrew, et al. [(9)] soil structure determines the size of surface runoff and the rate of saturation of land by water [(9)].

Organic materials have an influence in preventing erosion, among others, being able to increase soil aggregate stability and improve soil structure, increasing soil infiltration capacity so that organic materials can reduce surface flow and erosion. The low BV value is related to the nature of the pumis parent material which dominates the soil in this study area. Pumis is a pyroclastic material which is an accumulation of rock fragments released by volcanic explosions that occur due to gas release and is under pressure [(10)]. When the pumis undergoes a weathering process, the volcanic glas will dominate the coarse and medium fraction inside the ground [(11)].

The total soil pore space in the results of soil physical properties analysis (Table 1) is in the medium criteria with the% value of the total pore space being 74, 32. The total pore space is related to the properties of the parent material that dominates the soil in this study area. The volcanic glass which dominates the coarse and medium fractions in the soil (11) has very large pores, and is hollow and more porous.

Based on Table 1, it can be seen that the soil permeability in the study area is classified as very fast with a value of 46.04 cm / hour. The high value of soil permeability in this research area is closely related to other soil physical properties that have been analyzed, such as structure, texture. The granular soil structure in the study has a great ability in passing water, this is also supported by the texture of sandy clay soil. According to Vergani and Graf [(12)] that the high percentage of sand possessed by the soil causes the soil to be easily passed by water. Soil that contains a lot of dust and sand fraction has very weak cohesion between particles and is very easy to wash away water and easily saturates water, so that the infiltration decreases rapidly and the permeability of the soil increases.

Aggregate stability describes the aggregate ability to be able to survive against land-destroying factors. The formation of soil aggregates can increase the holding power of water on the ground. Based on the results of the analysis of aggregate stability that has been carried out as shown in Table 1, the value of soil aggregate stability is 58% with unstable criteria. If it is associated with its effect on erosion and landslides, unstable aggregate stability is easily destroyed by blows of rainwater into fine grains which will increase the rate of erosion and landslides.

1.2 Soil physical properties after the treatments

1.2.1 Organic matter

One of the characteristics of soil physical properties that play a role in the process of erosion and landslides is organic matter. Based on Table 1, the value of organic matter is still very low. According to Suriadi and Nazam [(13)] soils containing less than 2% organic matter are generally sensitive to erosion. The low content of soil organic matter causes a decrease in soil aggregation due to the absence of organic material which functions to absorb and hold water.

This causes the soil to be easily dispersed due to the kinetic power of rain water which triggers erosion and landslides. The effect of several ground cover plants on soil organic matter content is presented in Table 2

Tabel 2. Effect of cover crops on soil organic matter (SOM)

Treatments	SOM (%)
A : Control	0,64 a
B : cultivated with (*Vetiveria zizanioides*)	1,00 a
C : cultivated with (*Pennisetum purpuroides*)	1,44 a
D : cultivated with *(Tithonia diversifolia*)	0,79 a
E : cultivated with (*Pennisetum purpureum*)	0,85 a

Numbers in the same coloum followed by the different lower case word is significant difference by LSD *P=>0.05*

There is no real influence from each cover crop treatment on changes in soil organic matter content due to short plant growth and the age of young plants, where plants with young age and root systems are still small, so that a small amount of substrate is organic matter can be donated and maintained from the root zone, so that the contribution of plants to changes in soil properties has not been seen and is still very low.

Table 2 shows an increase in the amount of organic matter in each treatment. The highest increase in the value of organic matter is found in king grass plants with an average value of 1.44%. The high increase in the value of organic matter in the king grass species is due to the role and influence of the root system of the king's grass. The shape of the roots is fiber has more fine roots that are able to contribute organic matter and increase the content of organic matter in the soil.

1.2.2 Soil Bulk Density

The characteristics of soil physical properties that play a role in the process of erosion and landslides are soil BV. Based on the results of the research that has been carried out, the low volume weight soil as shown in Table 3 below. The low value of BV is related to the nature of the pumis parent material which is dominated by coarse and medium fractions in the soil [(11)]. This property causes the weight of the soil volume to be low. Low volume heavy soil causes the soil to become light and easily transported by water, this causes the land to be very vulnerable to erosion and landslides.

Different types of vegetation will affect the diversity of soil physical properties. Planting several types of ground cover plants has no significant effect on changes in the value of soil volume due to short plant growth and the age of young plants, so the contribution of plants to changes in soil properties has not been seen and is still very low. The effect of several ground cover plants on the weight values of soil volume (BV) is presented in Table 3.

Table 3. Effect of cover crops on bulk density

Treatments	Bulk density g/cm³
A : Control	0,57 a
B : cultivated with (*Vetiveria zizanioides*)	0,55 a
C : cultivated with (*Pennisetum purpuroides*)	0,54 a
D : cultivated with *(Tithonia diversifolia*)	0,57 a
E : cultivated with (*Pennisetum purpureum*)	0,54 a

Numbers in the same coloum followed by the different lower case word is significant difference by LSD *P=>0.05*

The results of the research that have been carried out, the BV values of the soil from each treatment showed a decrease in numbers. Based on the criteria for BV land values, BV values are at low criteria. There is a decrease in BV of the soil in king grass and elephant grass to 0.54 g / cm3. The presence of roots on the ground will accelerate land cover. Elephant grass has roots that grow in books from trunks that creep in the soil. King grass and elephant grass have fiber roots which can bind particles and form braids and lift nutrients that have been washed by rain water to the surface layer. According to Six et al., [14] the ability of grass roots in improving the physical condition of the soil begins with the formation of new aggregates with a larger diameter by the roots of grass fibers causing an increase in soil macro porosity and a decrease in soil volume.

1.2.3 Total pore space

The total soil pore space in the results of the analysis of soil physical properties as shown in Table 4 below is in the criteria of being medium. The total value of this pore space is related to the nature of the parent material that dominates the soil in this study area. The volcanic glass which dominates the coarse and medium fraction in the soil [11] has very large pores, and is hollow and more porous.

The effect of several ground cover plants on the value of total soil pore space (TRP) based on the results of variance analysis showed no significant effect on the total soil pore space (TRP) value. The effect of several ground cover plants on the total value of soil pore space (TRP) is presented in Table 4.

Table 4. Effect of cover crops on total pore space

Treatments	TRP (%)
A : Control	78,36 a
B : cultivated with (*Vetiveria zizanioides*)	79,79 a
C : cultivated with (*Pennisetum purpuroides*)	79,72 a
D : cultivated with (*Tithonia diversifolia*)	76,22 a
E : cultivated with (*Pennisetum purpureum*)	77,02 a

Numbers in the same coloum followed by the different lower case word is significant difference by LSD *P=>0.05*

Based on the total pore value of each cover crop as shown in Table 4, there is an increase in the total pore space in a number of cover crops in numbers. The increase in TRP value was seen in vetiver grass at 79.79% and king grass at 79.72%. Closing the soil with vegetation can be one way to increase soil porosity. Closing different lands can have a different impact on the number of pores formed. Dal Ferro et al. (2012) reported that there was a% increase in total pore space of 16% in lands covered by cover crops. Rooting will also affect the activity of microorganisms that will affect the increase in soil porosity. Indirectly the plant roots will bind the soil grains. In line with the research conducted by Gonggo [15] that planting grass cover types, namely king grass can increase the total pore of the soil by 12.50% when compared with the land without the presence of vegetation.

In addition, the difference in the total value of soil pore space in each treatment was associated with an increase in the value of organic matter in each treatment (Table 2). According to Kravchenko, et al [16] that soil organic matter is able to contribute to the formation of soil pores. Organic materials can create a balanced pore space between macro and micro pores for water transmission and retention, as well as aeration and good soil drainage.

1.2.4 permeability

Soil permeability in the study area is classified as very fast. The high value of soil permeability in this research area is closely related to other soil physical properties that have been analyzed, such as structure, texture. The granular soil structure in the study area has a great ability in passing water, this is also supported by the texture of sandy clay soil. According to Vergani and Graf [12] that the high percentage of sand possessed by the soil causes the soil to be easily passed by water. Soil that contains a lot of dust and sand fraction has very weak cohesion between particles and is very easy to wash away water and easily saturates water, so that the infiltration decreases rapidly and the permeability of the soil increases.

Permeability also has an influence on the occurrence of erosion and landslides, where the slower the permeability in the soil, the land in this area will be more easily eroded. Based on the results of the research that has been carried out, the results of the analysis of variance that have been carried out, each treatment shows a significant effect on soil permeability. The effect of several cover crops on changes in soil permeability values can be seen in Table 5.

Table 5. Effect of cover crops on soil permeability

Treatments	'ermeabilitas (cm/jam)
A : Control	46,88 a
B : cultivated with (*Vetiveria zizanioides*)	40,19 b
C : cultivated with (*Pennisetum purpuroides*)	37,39 c
D : cultivated with *(Tithonia diversifolia*)	40,21 b
E : cultivated with (*Pennisetum purpureum*)	36,21 c

Numbers in the same coloum followed by the different lower case word is significant difference by LSD *P=>0.05*

Table 5 shows that there is a decrease in the rate of soil permeability in each cover crop. The soil permeability values based on the criteria of soil physical properties are at very fast criteria. However, numerically each cover crop showed a decrease in the value of soil permeability and a significant influence between treatment and control (land without planting cover crops).

Decreasing the value of soil permeability was also seen in vetiver grass with a value of 40.19 cm / hour and titonia with a value of 40.21 cm / hour. Different cover crops also have different effects on soil permeability. Based on the results of a study by Burrie et al [(17)], it was shown that an increase in land cover by vegetation / plants had an effect in reducing the rate of soil permeability. According to Archer, et al [(18)] plant roots are able to bind soil particles through root exudates. `Physical, biological and chemical interactions in the soil will affect soil aggregate stability and soil structure. The structure of the soil will affect the ability of the soil to escape water, resulting in decreased soil permeability.

3.3.5 Agregat stability

The value of soil aggregate stability based on the results of the analysis of soil physical properties in the research that has been carried out is in the unstable criteria. If it is associated with its effect on erosion and landslides, unstable aggregate stability is easily destroyed by blows of rainwater into fine grains which will increase the rate of erosion and landslides. Low aggregate stability will cause the soil structure to be easily destroyed by raindrops. This causes the soil pores to be clogged by particles of aggregate that are destroyed so that the soil is easily compacted and the soil will easily erode [(9)].

Table 6. Effect of cover crops on aggregate stability

Treatments	ıgregat stability
A : Control	34,10 a
B : cultivated with (*Vetiveria zizanioides*)	35,63 a
C : cultivated with (*Pennisetum purpuroides*)	37,44 a
D : cultivated with *(Tithonia diversifolia*)	35,04 a
E : cultivated with (*Pennisetum purpureum*)	35,22 a

Numbers in the same coloum followed by the different lower case word is significant difference by LSD *P=>0.05*

Based on the criteria for soil aggregate stability index, the value of soil aggregate stability in each treatment is in the unstable criteria. The effect of several ground cover plants on the value of soil aggregate stability is presented in Table 6. Based on Table 6 above, it can be seen in each treatment that it has not shown a change in the level of aggregate stability to form a more stable and stable soil aggregate. Ground cover plants that are still 3 months old, have not shown the effect of each cover crop and have not been able to form more stable aggregate stability. However, the effect of each of these cover crops has a change in the value of soil aggregate stability in numbers when compared to controls (without treatment).

Amezketa [19] and Burrilo [20] Shows that plant roots have a positive influence on soil aggregation and stability. Root tissue with many fine roots and fiber roots will form a binding network between soil particles. The same opinion according to Kokutse et al., [21] that plant roots are able to influence soil structure by releasing various organic and inorganic substances through root exudates containing polysaccharides which act as binding agents for soil grains.

1.3 Plant Parameter

3.3.1 Height and total leaves

The growth of cover crops with grass species (treatments B, C and D) has faster growth compared to plants with shrub species such as titonia plants (treatment E). This can be seen from the existence of significant differences between treatments on plant height and number of plant canopies. Each level of growth, vegetation with this type of grass and shrub plants can grow on all types of soil and has good adaptability, such as vetiver grass capable of growing on soils rich in clay and sand.Differences in plant growth rates such as plant height and number of plant canopy in several types of cover crops as shown in Figure 2.

Increasing plant height from the four types of cover crops, showed that plants with grass species had faster vegetative growth compared to shrub cover crops. More observations on plant height and number of plant canopy in each experimental plot can be seen in Table 7. Plant height as in Table 7 vetiver grass growth is faster when compared to king grass, elephant grass and titonia. This is because the vetiver grass is easy to grow, can grow from lowland to highland, and this type of grass can grow in soil conditions dominated by clay and sand texture. Bhushan et al., [22] stated that the soil conditions suitable for the growth of vetiver grass were sandy soil (andosol) or volcanic ash on hill slopes. Soils with these characteristics will cause the plant roots to become long and dense, and the roots can be easily removed without being left behind. Vetiver grass can also grow on various substrates, such as: clay, clay, crushed limestone, sandy clay loam, and mixed peat.

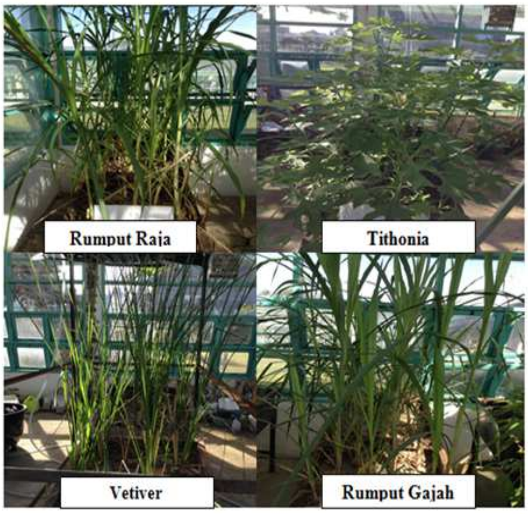

Fig 2. Growing plant on the plot

Table 7. Plant height and total leaves

Preatments	height (cm)	Total leaves (number)
A = Control	0,00 b	0,00 b
B = cultivated with (*Vetiveria zizanioides*)	58,68 ab	15,33 ab
C = cultivated with (*Pennisetum purpuroides*)	52,52 ab	9,33 ab

D = cultivated with (*Tithonia diversifolia*)	25,36 a	15,00 a
E = cultivated with (*Pennisetum purpureum*)	45,76 ab	9,67 ab

Numbers in the same coloum followed by the different lower case word is significant difference by LSD *P=>0.05*

From the four types of titonia cover plants the lowest plant height is compared to other plants. The plant height at titonia is still relatively low when compared to covert type grass plants, where the average height of titonia plants at the age of 3 months has only reached 45.76 cm. However, when viewed from the number of canopy, titonia has more and more dense number of leaves / plant canopies. In addition, vetiver grass (treatment B) has more leaves.

Basically vegetation can affect erosion due to interception of rainwater by plant canopies. In other words, the lower the plant meeting and the more effective the influence of vegetation in protecting the surface of the soil against the threat of erosion because it will reduce the speed of the terminal of rainwater, so that it can reduce the amount of raindrops to the ground.

3.3.2 Plant root development

Table 8 shows that the root density of several types of cover crops has different values, as well as the density of each cover crop. This difference is seen in each cover crop. The following is a picture of each root of several types of ground cover plants used in this study. The full results of observations on the root root system of each type of cover crop can be seen in Table 8.

Root density (g / cm3) and rooting area ratio (cm) are the main indicators used in determining and evaluating the effect of root systems in controlling surface flow and erosion. Where the greater the root density value (KA) and rooting area ratio (RLP), the rate of land release rate will be smaller. This is supported by the opinion expressed by Loades, et al [22] that the magnitude of root strength in binding to soil particles is determined by an increase in the ratio of the root area and root density.

Table 8. Plant root development

Treatments	KPT (g/cm^3)	KPA (cm^2)	RLP (cm)	LTPT
A = Control	0	0	0	0
B = cultivated with (*Vetiveria zizanioides*)	0,005	0,06	1,126	0,996
C = cultivated with (*Pennisetum purpuroides*)	0,005	0,05	0,847	0,996
D = cultivated with (*Tithonia diversifolia*)	0,002	0,04	0,534	0,999
E = cultivated with (*Pennisetum purpureum*)	0,003	0,05	1,024	0,998

note : KA: Plant Rooting, KPA : Root Length Density, RLP : Rooting Area Ratio, LTPT : Rate of soil release

Vetiver grass (treatment B) and king grass (treatment C) have the largest root density value of 0.005 g / cm3 when compared to elephant grass and titonia. From Table 9, it can be seen that the three types of grass have a higher root density value than titonia (0.002 g / cm3). The root density value affects the rate of soil release rate, where the higher the root density value and rooting area ratio, the lower the rate of soil release by roots.

Clumps of land cover plants have denser roots and are much larger than titonia plants. Observation of the root system is very important in seeing how much the ability of the soil and plants to suppress surface flow and erosion, and is useful in selecting plants that are most suitable for erosion control.

3.3.3 Runoff and erosion

Cultivating several types of cover crops in each treatment had a significant different effect on surface flow volume. The presence of dense ground cover plants is a flow inhibitor, as a result the infiltration time increases and of course the velocity of the surface flow decreases. Read more about the effect of planting different types of ground cover plants on the amount of surface runoff and erosion can be seen in Table 9.

Table 9. Effect of cover crops on runoff and erosion

Treatment		Runofff (l/m^3)	erosion (g/ m^3)
A	= Control	75,33 a	2332,33 a
B	= cultivated with (*Vetiveria zizanioides*)	54,00 b	776,67 ab
C	= cultivated with (*Pennisetum purpuroides*)	50,00 b	580,00 c
D	= cultivated with *(Tithonia diversifolia*)	50,46 b	553,11 c
E	= cultivated with (*Pennisetum purpureum*)	54,23 b	658,24 bc

Numbers in the same coloum followed by the different lower case word is significant difference by LSD *P=>0.05*

The decrease in surface flow volume for each cover crop as shown in Table 9 shows the difference in the ability of each plant to suppress surface flow rates and give large eroded soils. The interactions of each treatment reveal significant effects both on surface flow and on the amount of soil erosion.

The decrease in surface flow rate is directly proportional to the decrease in the amount of eroded soil. The ability of plants to reduce surface flow shows a decrease in surface flow volume and the amount of eroded soil. Evans [23] argues that the low surface flow due to the rate of infrasion of water through vegetated surfaces is higher than that of open soil.

Based on Table 9, there is a decrease in the volume of surface flow and the amount of eroded soil, where the use of king grass (treatment C) with an average surface runoff volume of 50.00 l / m3 and titonia of 50.46 l / m3 when compared to soil without treatment (control) with an average surface flow value of 75.33 l / m3. While the effect of cover crops on the size of eroded soil was also seen by a decrease in the amount of soil eroded in the treatment of king grass and titonia plants.

The volume of surface runoff and soil eroded is influenced by the number of canopy and root systems in the king grass. Where on the king's grass, the roots of the roots of the king's grass plant have the ability to absorb and store more water and are able to maintain the stability of the soil against changes in water content, so as to be able to withstand landslide.

Plant heads that cover the surface of the soil can reduce the energy of falling raindrops, so that when it reaches the surface the strength has been reduced to dispersing the soil. The greater number of plant canopy affects the amount of water that penetrates the canopy and reaches the surface of the land through interception, the dense stands of plant stems in addition to inhibiting surface flow also prevent rapid collection of water on the ground, thereby reducing the amount and strength of surface flow this land surface can ultimately reduce erosion.

Besides direct influence, plants can also reduce the rate of erosion indirectly. In this case through its influence on the nature of the soil. The existence of plants will increase soil mass resistance to rainwater destruction and runoff runoff, in addition, the influence of cover crops can improve soil structure and improve soil aggregate stability so as to minimize surface flow. Vegetable soils have a better structure and more stable aggregates. According to [11], where the level of soil stability and soil resistance to rain dispersion power will be influenced by the existence of plant root systems.

IV. Conclusion

It can be concluded that the effect of cover crops on the changes in soil physical properties has not been seen, but there has been an effect of increasing the value of aggregate stability on the king grass plants. Observed a decrease in surface flow rate in titonia plants. For herbaceous plants, king grass gives a greater influence on decreasing the flow rate followed by vetiver grass and elephant grass. The level of development of vetiver grass roots with different ages will show the influence of plant root systems. Plant roots affect erosion, plant root systems help to form and stabilize soil aggregates.

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