Influence of Intercropping between Vetiver Grass and Cover Crops on Soil and Water Conservation and Growth of 'Namdokmai Seetong' Mango

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ABSTRACT

Study on the influence of intercropping between vetiver grass, cover crops (sword beans and lablab beans) and 'Namdokmai Seetong' cv. mango plantation at Kanchanaburi Research Station in 2009 – 2010. The research was undertaken at the mango, measurements of the stem perimeter of the mangos were taken 6 and 8 after planting. These measurements were 9.45 and 11.05 centimeters, respectively. The non intercropping vetiver grass were larger than the mango with vetiver grass (8.85 and 10.32 centimeters), 2 and 6 months after planting of stem height mangos (89.28 and 112.01 centimeters) were greater high significantly different of the mango with intercropping between vetiver grass (83.86 and 106.88 centimeters), respectively. 2 months after planting mango tree without intercropping with cover crops, it had the greatest height of average of canopy (between the narrow part and width) (62.55 centimeters) significantly different, and the intercropping among grass, mango and sword beans showed the least (58.14 centimeters). The 2, 4, 6, 8 and 10 months after planting of mango by intercropping and without vetiver grass, sword beans and lablab beans, it was not different on the soil sedimentation and volume of water flush. The stem diameter, height, and canopy of mango trees after planting for 2, 4, 6, 8, 10 and 12 months were not significantly different.

Keywords: vetiver grass, soils and water conservation, sword bean, lablab bean, and mango

INTRODUCTION

Kanchanaburi Research Station is under the Agricultural-Ecological system Research and Development Institute, Kasetsart University located in Moo 9, Wangdong Sub-District, Maung District, Kanchanaburi. The location is approximately 50 meters a sea level. The ground condition is very dry and the soil is poor quality. It has low rainfall and dry spell. The total operating area is 447 rai.

The surrounding landscapes is mountainous with complex forest in the west. In some years, the area has heavy rain will cause soil erosion, water runoff and landslides. It is sometime drought. Therefore, the growing of vetiver grass should be done in order to conserve the soil and water. There is a variety of biological resources and a lot of potential for soil and water conservation (Carlin *et al*., 2003).

Vetiver grass is a grass family which grows well and has deep and complete roots. It can endure drought condition or grow well in the infertility soil the plant could be use for soil and water conservation as well as for retaining moisture in soil and absorption of water in soil over a long time period (Leaungvutiviroj *et al*., 2001; Massardo *et al*., 2004; Carey, 2006; Srivastava and Kayasta, 2008). Furthermore, it can absorb the toxic contaminants in the natural water resource there by producing good quality of water and increasing water

good safety (Walsh, *et al*., 2003). People who drink and use this water source will have good health and a life benefits.

The growing of vetiver grass helps to preserve and protect efficiently the soil and water (Wikipedia, 2011). It raises the soil fertility (amount of nutrients: nitrogen, phosphorus and potassium) and adds organic matter to the chemical and biological structure of soil (Dinesh *et al*., 2006), and increase yields of the main crops (Agamuthu *et al.*, 2003). The cover crop system also helps to decrease weeds very well (Ekeleme *et al.*, 2004a, 2004b; Chikoye *et al.*, 2001; Vohland and Schroth, 1999).

Intercropping system can help to improve soil for fruits production, vegetables, short-lived plants, and other plants as well (Coaker, 1980; Chen *et al*., 2003; Sarkar *et al*., 2010).

There are four types of recommended Fabaceae of cover crops in the para rubber plantation number: calopogonium, centrosema, pueraria, and caeruleum. The first three types can easily find seeds and caeruleum gives the most humus. Planting period of sprinkling and sowing the seeds should be used to plant the first three types with ratio 5:4:1 or 2:2:1.

There are two varieties of cover crops namely Jack bean (*Canavalia ensiformis*) and Sword beans (*Canavalia gladiate*). They can produce the nutrients after being ploughed for 2-3 weeks containing of N, P, and K around 3.04, 0.37, and 3.12 respectively (Department of Agriculture, 2007; Salako *et al*. 2006)

In addition, lablab bean is Fabaceae which is fruticose (cow pea). It has strong stem, and grows well. If there is good enough water, good soil, good climate, it may grow and have vine. It is well tolerant to the dry climate, diseases and bugs (Carey *et al*., 2006)

According to the reasons and importance mentioned above, the researches of the influence of intercropping between vetiver grass and cover crops of Fabaceae (sword beans and lablab beans) on the soil and water conservation area to produce fruits ('Namdokmai Seetong' mango) in the drought and less rain at Kanchanaburi Research Station is done. Furthermore, it will improve the environment and help local people to get good income and have a good life.

MATERIAL AND METHODS

1. Experimental design

Experimental design was used with 2x3 factorial styles in RCB (randomized complete block design) containing 2 factors. The first factor was the growth of vetiver grass. There were two methods treatment that were the planting with and without vetiver grass. The second factor was the cover crops. There were three methods that not cover crops, cover crops by sword beans and lablab beans respectively. The total was six treatment combinations. In each treatment combination, there were four replications. In each replication, had 360 square meters.

2. Material plants

The Surathani vetiver grass was grown as intercropping between 'Namdokmai Seetong' mango which was one year old. The spacing of growing (space of tree x row) was 5x8 meters and space between the vetiver grass was half around (radius was 1.8 meters). The sword beans and lablab beans were planted as cover crops (spacing was 50x75 centimeters) in the mango plantation around.

3. Researched tropic:

3.1 Mango trees:

3.1.1 Cultivar: 'Namdokmai Seetong' mango aging one year old.

3.1.2 Stem perimeter: Measured the length of stem perimeter by the tape measure unit at the level of height above the earth 20 centimeters.

3.1.3 Stem height: Measured the height of the stem using the tape measure.

3.1.4 Stem canopy: Measured the narrow part and width of the most stem canopies and the average be the size of stem canopy. The growth of stem perimeter of mango at the level of height 20 centimeters, the size of canopy (narrow part and width), and height of stem were recorded every three months and the mature fruits were harvested.

3.2 Vetiver grass:

3.2.1 Stem height: Measured the height of vetiver grass at the highest position every two months.

3.2.2 Stem canopy: Measured the length of narrow part and width of canopy of vetiver grass at the widest point every two month.

3.2.3 Total weight: After planting, in every two months the vetiver grass was cut at the level of height above the earth 20 centimeters the good weight of vetiver grass in each treatment combination was recorded and then they were used as the cover crops around the vetiver grass area and the width was 1-2 meters.

3.3 Cover crops:

3.3.1 Type of cover crops: The sword beans and the lablab beans were cultivated as cover crops.

3.3.2 Total weight: When the beans flower bloomed, the cover crops must to be cut good weight of cover crops in each treatment combination was recorded.

3.3.3 Harvesting cover crops: according to 3.3.2, it was hacked to small pieces, sprinkled on the ground, and mixed with soil around the area of cover crops.

3.4.1 Soils fertility:

The sample of the soil in the treatment combination was collected before and after planting the vetiver grass and 'Namdokmai Seetong' mango annually in order to analysis the soil fertility according to the method of Mengel and Kirkby (1987). The analysis was done to find out the amount of nutrients that were nitrogen, phosphorus, potassium, calcium, magnesium, and pH of soil.

4. Statistical analysis: Average was compared according to the method of DMRT (Duncan new multiple range test) at the confidence of 95 percentages.

5. Location site: The test was operated at Kanchanaburi Research Station, Wungdong Sub District, Meung District, Kanchanaburi located at GPS of 47P 0535576, 47P 0535534, 47P 0535656 and 47P 0535684 (in the system UTM at 561213, 1561166, 1561069 and 1561087) respectively. The GPS, Garmin GPS 60 CSx was used to read and the test was conducted on 25 November 2009.

RESULTS and DISCUSSIONS

1. The Growth of 'Namdokmai Seetong' Trees

1.1 Stem perimeter

Six months after planting, the mango tree which was not grown with vetiver grass has stem perimeter (9.45 centimeters) (Figure 1) more than the mango tree which was cultivated with vetiver grass (8.85 centimeters) and they were different significantly statistically. However, after planting as 8, 10, 12, 14, and 16 months, the stem perimeters were same and after planting 2, 4, 6, 8, 10, 14, and 12 month of mango trees grown in

cover crops with sword beans and lablab beans were not different including there was no interaction between cover crops with vetiver grass and cover crops with sword beans and lablab beans to the stem perimeter.

1.2 Stem height

Four months after planting, mango tree which was not grown with vetiver grass had stem height (112.01 centimeters) (Figure 2) more than mango tree which was cultivated with vetiver grass (105.88 centimeters) and they were different significantly statistically. On the other hand, after planting for 6, 8, 10, 12, 14, and 12 months the mango tree both cultivated with and without vetiver grass with plus planted and without cover crops with sword beans and lablab beans had the same stem height and then not an interactions in every factors mentioned above to the height of stems. It was because the mango trees grow better than the mango tree in other treatment combinations. When after planting four months, the mango tree in the treatment combination growing up in the same at the height level.

1.3 Canopy of mango tree

The 2, 4, 6, 8, 10, 12, 14, and 16 months after planting, the mango tree in every treatment combination had the same size of canopy (Figure 3). In contrast, two months after planting, mango trees which were not planted with the vetiver grass had the greater canopy size of was 62.55 centimeters (Figure 3) and it was significantly different statistically. The 6, 8, 10, 12, 14, and 16 months after planting of the canopy of mango tree, and there was no interaction between planting with and without vetiver grass with plus with and without the cover crops with sword beans and lablab beans. They were not different canopy. (Figure 3)

2. Vetiver grass

2.1 Stem height

The 2, 6, 8, 10, 12, 14, and 16 month after planting, the height of vetiver grass with and without the cover crops with beans were not different (Figure 4) because the vetiver grass plantation had the drip irrigation system. It can be used the water on grass equal and sufficient that makes the grass grow up continuously (Carey, 2006).

2.2 Total weight

The both of 10 and 14 months after planting, the vetiver grass which was not grown with cover crops with beans had the greatest total weight 1.97 and 1.40 kilograms (Figure 5) respectively. Furthermore, when cultivating with cover crops with sword beans, there were the least weights 0.80 and 0.83 kilograms per replication, respectively.

2.3 Clump canopy

The 2, 6, 8, 10, 12, 14 and 16 months after planting, the vetiver grass which was planted with and without cover crops with two varieties of beans (sword beans and lablab beans) had not difference of clump canopy (Figure 6) according to the same reasons in (Stem Hight (2.1)).

2.4 Number of plants

The both of 10 and 14 months after planting, the vetiver grass which was planted without the cover crops with beans had the most clumps that were 5.68 and 5.36 clumps per replications (Table 1) and the grass which was planted with cover crops with sword beans had the least clumps that were 4.83 and 4.22 clumps per square meters. For the other period, the results were not different because cultivating the beans which were used as cover crops, may not have the interaction or not have the damages of vetiver grass.

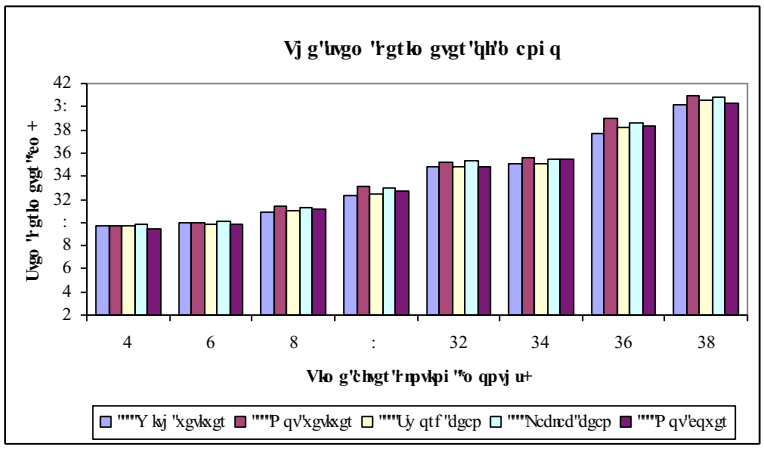

Figure 1 The stem perimeter of 'Namdokmai Seetong' mango, after planting for 2, 4, 6, 8, 10, 12, 14 and 16 months

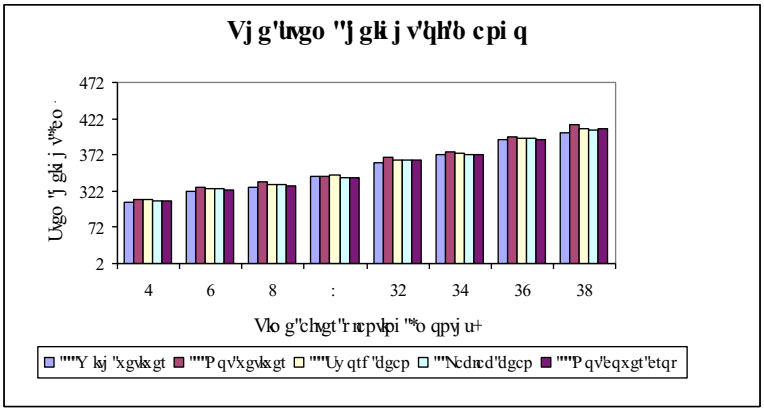

Figure 2 The stem height of of 'Namdokmai Seetong' mango, after planting for 2, 4, 6, 8, 10, 12, 14 and 16 months

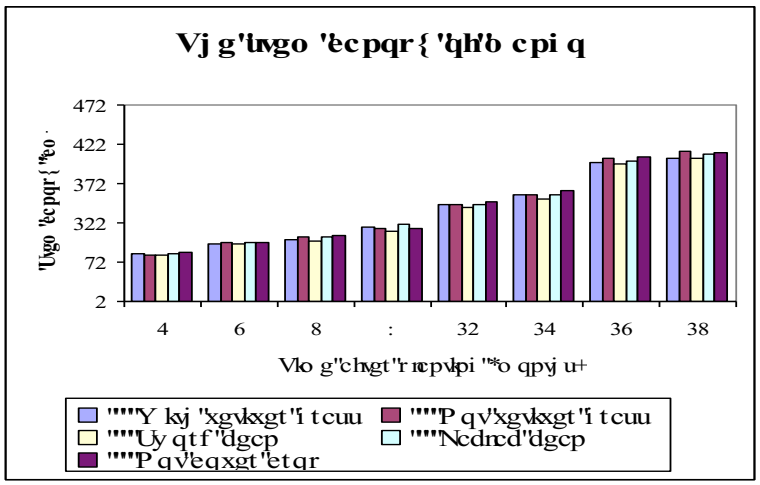

Figure 3 The stem canopy of 'Namdokmai Seetong' mango, after planting for 2, 4, 6, 8, 10, 12, 14 and 16 months

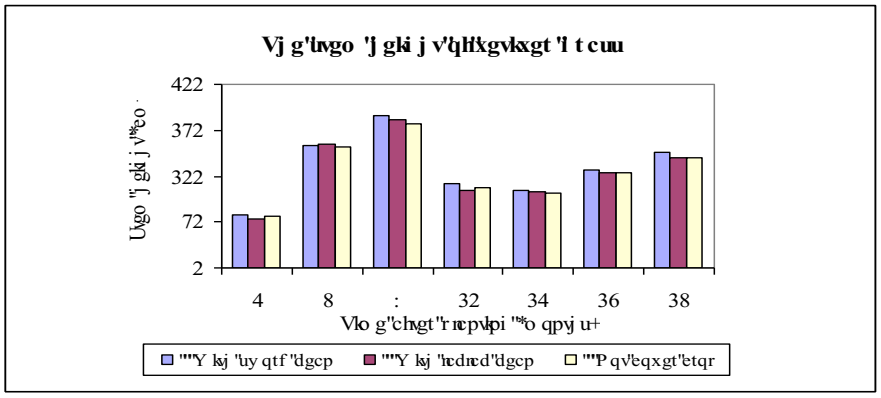

Figure 4 The stem height of vetiver grass with intercropping between cover crops (sword bean and lablab bean), after planting for 2, 4, 6, 8, 10, 12, 14 and 16 months

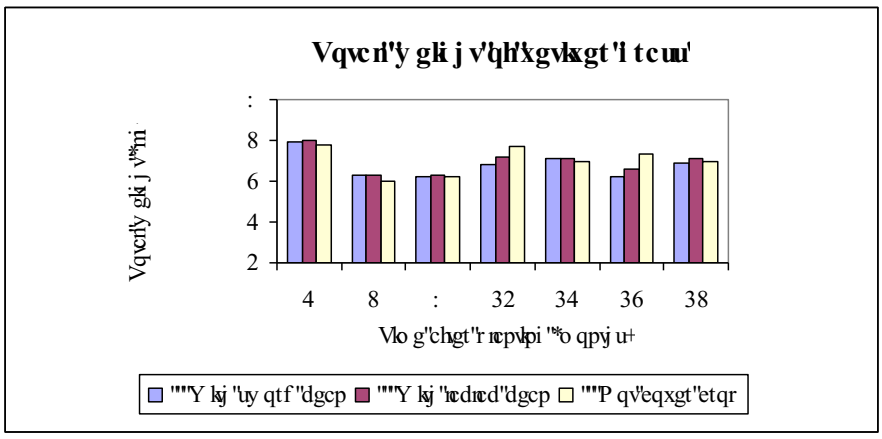

Figure 5 The total weight of vetiver grass with intercropping between cover crops (sword bean and lablab bean), after planting for 2, 4, 6, 8, 10, 12, 14 and 16 months

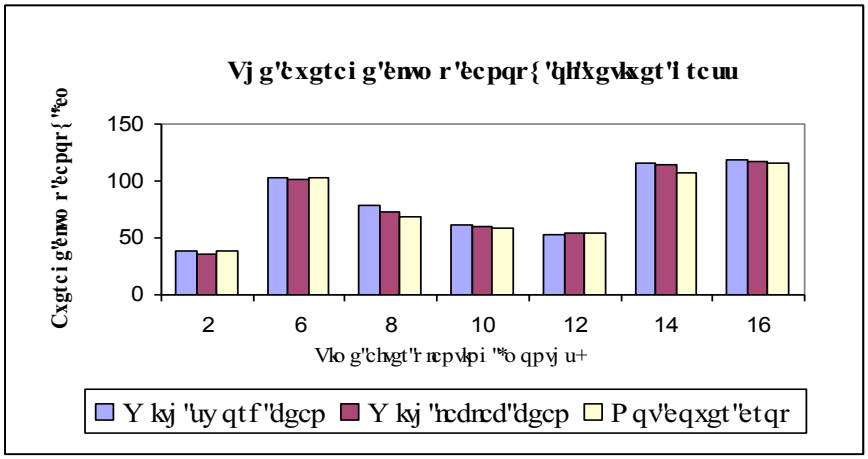

Figure 6 The clump canopy of vetiver grass with intercropping between cover crops (sword bean and lablab bean), after planting for 2, 4, 6, 8, 10, 12, 14 and 16 months

Table 1 The number of plants/m ^{2} of vetiver grass with intercropping between cover crops (sword bean and lablab bean), after planting for 2, 4, 6, 8, 10, 12, 14 and 16 months

Treatments	Number of plants/m^2)[1/]						
	2 months	6 months	8 months	10 months	12 months	14 months	16 months
With sword bean	5.92	4.28	4.23	4.83 b	5.09	4.22 b	4.91
With lablab bean	6.02	4.27	4.33	5.16 ab	5.15	4.62 b	5.14
Not cover crop	5.79	4.02	4.19	5.68 a	4.97	5.36 a	5.00
F-test	ns	ns	ns	*	ns	**	ns
C.V. (%)	7.74	5.62	7.34	5.09	2.36	4.45	9.82

[1/] Means in the same column followed by a common letter were not significantly different at P < 0.01 level by Duncan's new multiple range test.
ns: non significantly different, *: high significant different at P ≤ 0.05 and **: highly significant different at P < 0.01

3. Cover crops

3.1 Weight mass

The lablab bean which was not planted with vetiver grass had the most mass weight of 2.81 kilograms per square meter (Figure 7) and sword beans was not planted with vetiver grass had the least mass weight of 0.18 kilograms per square meter. because lablab beans can grow better than it was not intercropping plot with vetiver grass. On the other hand, the sword beans can grow better in the intercropping with vetiver grass plantation than not intercropping with vetiver grass plot. because vetiver grass can keep more moisture in the soil (Sunantapongsuk and Piriyprin, 2001).

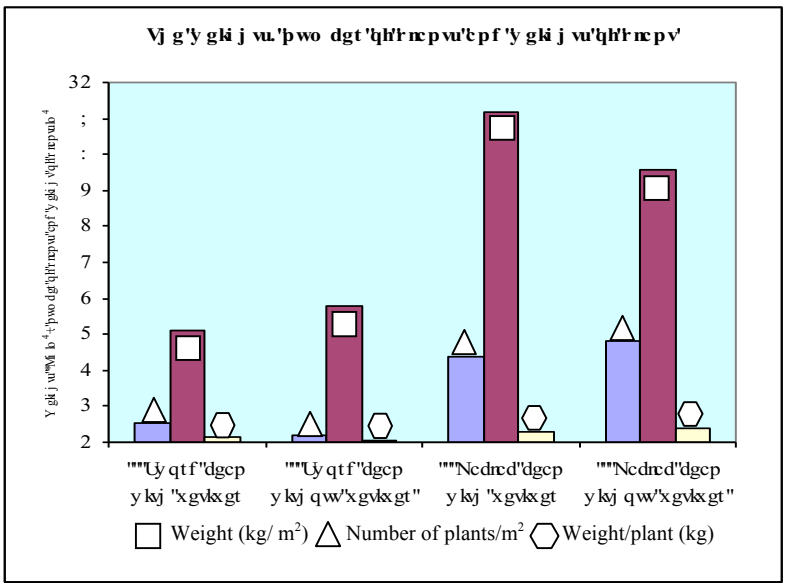

Figure 7 The weight, number of plant and weight per plant of cover crops (sword bean and lablab bean) intercropping between and vetiver grass in 'Namdokmai Seetong' mango plantation.

3.2 Number of plants

Lablab beans were planted with vetiver grass had the most number of plants with 9.18 trees per square meter (Figure 7). The sword beans were planted with vetiver grass had the least number of plants with 3.12 tress per square meter since the location of the Kanchanaburi Research Station with is the area has low rainfall and lablab bean can grow better than sword beans.

3.3 Plant weight

Lablab bean was not planted with vetiver grass had the most plant weight with 0.38 kilograms per plant (Figure 7) and sword beans were not cultivated with vetiver grass had the least per plant weight with 0.05 kilograms per plant since lablab bean can grow better in the alkali soil and in the area has low rainfall in the same reasons as sub tropic of 3.2 (Number of plants).

4. Water runoff

The 5, 8, 9, and 10 months, after planting mangoes, the water runoff through the 'Namdokmai Seetong' mango plantations which was planted with and without vetiver grass, sword beans and lablab beans were not different (Figure 8) and all the plants are young and the plantation is in less-slope of water trap-pond system was not good enough. (Grimshaw, 2011)

5. Quantitative soil sediment

The amount of soil sediment from the all treatment combination which were planted with and without vetiver grass, sword beans and lablab beans, were not different the same reasons in water runoff (4.) (Figure 9).

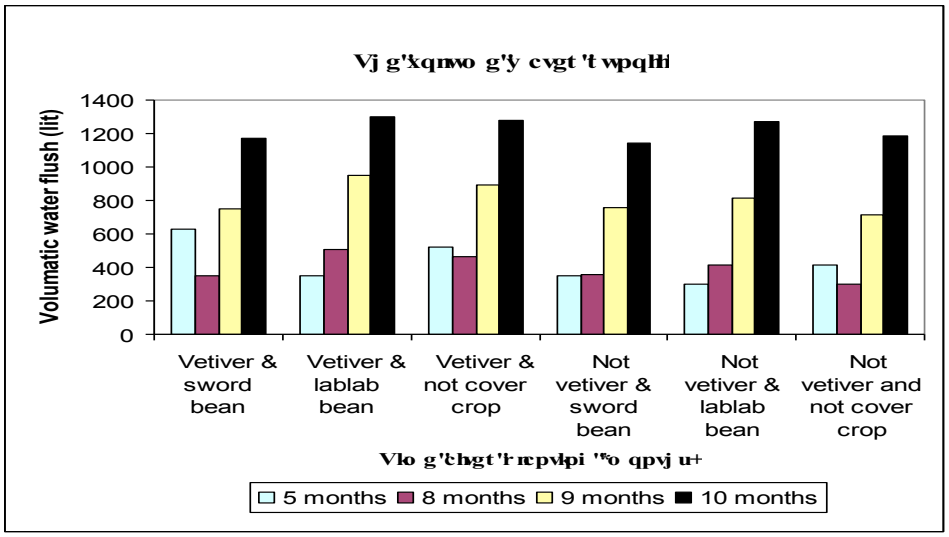

Figure 8 The volume of water runoff from intercropping between vetiver grass and cover crops (sword bean and lablab bean in 'Namdokmai Seetong' mango plantation

CONCLUSIONS

1. The 8 – 16 months after planting of the 'Namdokmai Seetong' mango was plants with and without vetiver grass, two cover crops: sword bean and lablab bean, there were not significantly different of growth in the stem perimeter, height, and size of canopy.

2. The height and size of canopy of vetiver grass with and without cover crops (sword bean and lablab bean) were not different, but in the rainy season (1,200 millimeters) vetiver grass was planted without both types cover crops had more weight and number of clumps than planted with both types of cover crops.
3. The lablab bean was cultivated with vetiver grass grew better in the environment of the Kanchanaburi Research Station making more mass weight and number of plants than sword bean which grew lesser.
4. Vetiver grass and cover crops did not affect the volume water runoff and quantity of soil sediment.

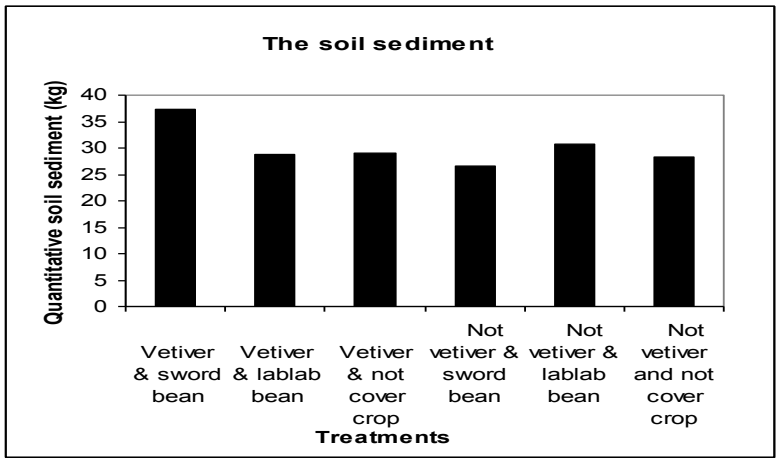

Figure 9 The quantitative soil sediment from intercropping between vetiver grass and cover crops (sword bean and lablab bean in 'Namdokmai Seetong' mango plantation

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