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The Different Vegetation Materials with Cement and Mushroom Waste Compost for Hydro seeding Test

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***Abstract*—The application and improvement of mixed materials of hydro seeding allows fast planting and greening for rapidly covering landslides and reducing runoff to decrease second damage and provide basement conditions for plant growth. Total 13 test recipes containing Portland cement, loamy sandy soil and mushroom compost with land-slope 35° are studied. The physicochemical properties, such as pH value, hardness, water retention, germination potential and electrical conductivity (EC) are analyzed with the mushroom compost ratio and cement ratio. The significant results are presented with the situation of slope land protection.**

***Index Terms*—Hydro seeding materials; Mushroom compost; Portland cement; Seed germination percentage;**

I. INTRODUCTION

Slope land is quite easily eroded and it also results to the nude land surface and the shallow layer fertile soil, which is good for plants living, lost from the damage flood erosion and soil collapsing. In order to quickly cover to large area of eroded slope land, inducing the hydro seeding method with the adhesion, water retention, and reformation materials and the land-sliding protection engineering to effectively make the slope-land safe becomes a benevolent topic. Telysheva and Shulga ([1]) found silicon cohesive agents could form a membrane to prevent the water lost. Shulga *et.al*,([2]) used the by-production of papermaking and developed NH3 resin man-made-soil mixed materials to reinforce the resistance of 0.16~0.98 MPa for the anti-interpenetration on the slim layer, 1.2~10.2 mm of the soil surface, and these mixed materials also could reduce the soil lost to 20~25% with wind speed 25 m/s, 30~35% because of rain-drop impact and 40~45% from the runoff erosion. S. H. Lin et. al,([3]) showed the different hydro-seeding concentration prescription and obtained the thicker the concentration the larger the soil pH with the larger geometric-mean grain diameter; meanwhile, the water retention and the ability for anti-erosion could arise with material tension 0~2bar. Igwe et al.([4]) gave that the parameter of water retention of unit weight and found it, besides potential energy, was an important factor on plant growth. Fernández-Gálvez J.& Barahona E. ([5]) constructed the water contain curve of Hydro-seeding materials for prediction on water usability and water mobility in soil. *Lolium multiflorum* with various adhesive agents is a very popular study nowadays. Wu ([6]) presented hydraulic conductivity tests of adhesive agent recipes, and he obtained higher saturated hydraulic conductivity. Chiang ([7]) and ([8]) showed the function of different macromolecular adhesive agent concentrations on mudstone and red earth for the purpose of efficiency of adhesion and germination percentage. Yet, we are lack of the utilization of cement as the adhesion agents of hydro seeding materials, and that is why recipes containing Portland cement, loamy sandy soil and mushroom compost are selected for this study.

II. MATERIAL FOR TESTING AND THE RESEARCH METHODS

A. Contains of the mixed materials

Mushroom compost is made from the surplus of mushroom picked with the process of compost and ferment. It contains 95% saw dust and 5% rice、corn and wheat bran. Loamy sandy soil is taken from the Jhuoshuei River and the Portland type I cement is used as the adhesive agent.

B. Research Methods

With the different prescription ratio among mushroom compost loamy sandy soil and Portland cement and completely mixing them up, the mushroom compost mixed materials recipes will be used to progress the series of physicochemical property testing, such as pH、wet-sieve analysis、electric conductivity (EC)、hardness and water retention, consistent the germination test, too in order to find out the optimum ratio of prescription for hydro-seeding.

C. Compost of the testing recipes

Group I: volume ratio of mushroom compost to loamy sandy soil, 6. and 40%; Group II: 80% and 20 , and Group III: 90% and 10%. Each group is added Portland cement 1％、3％、5％ or 7％ of weight of dried mixed materials recipes; Group IV (the original sample) with 100％ mushroom

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compost. Totally 13 test recipes (Table 1) are presented in Table 1. Dry bulk densities of mushroom compost and loamy sandy soil are 0.2115g/ $cm^3$and 1.96g/ cm^3, respectively. The bulk density of loamy sandy soil is 1.5g/ cm^3; Referenced on the mix ratios of cement-sand mortar, the maximum soil water contain will be between 60 to 80% and the man-made slope is 35°.

Table 1 Test medium scale form.

HSM Group / Test		Mixed Material		PCR	Remark
		MC compost	LSS		
Ⅰ	1	60%（507.6g）	40%（3136g）	7%（204g）	
	2	60%	40%	5%（146g）	
	3	60%	40%	3%（88g）	
	4	60%	40%	1%（30g）	
Ⅱ	5	80%(676.8g）	20%（1568g）	7%（133g）	
	6	80%	20%	5%（95g）	
	7	80%	20%	3%（57g）	
	8	80%	20%	1%（19g）	
Ⅲ	9	90%（761.4g）	10%（784g）	7%（95g）	
	10	90%	10%	5%（68g）	
	11	90%	10%	3%（41g）	
	12	90%	10%	1%（14g）	
Ⅳ	13	100%（846g）	0%	0%	Original

HSM: Hydro-seeding materials;
MC: mushroom compost; LSS: loamy sandy soil; PCR: Portland cement ratio;

D. Test Methods

Mixed material pH-value and the electric conductivity could be tested by portable pH meter (EUTECH ECOSCAN) and conductivity meter (330i/set), respectively；soil hardness is obtained from the mean values of three testing by soil hardness tester, Yamanaka type【AF153】. The testing methods with their processes of water retention and polisoil wet-sieve analysis (or gradation test) are described as following：

1. Water retention test

The test of investigation for water retention is a main instrument to evaluate the application on germination efficiency, including the percentage and the potential. Each recipe is added water to the saturated condition and we weigh it after 24hrs. The weight is measured one time per day for 28days long and at the same time for recording the data.

2. Test of wet-sieve analysis

We randomly form the recipe in grains with2-5mm diameter. The grain is put into water and vibrated in the frequency of 30 times per minute. These grains are screened from the test of sieve analysis for analysis of aggregate. The grains on each sieve is in air-dried and baked in 105℃. We measure the dry weight and record its corresponding representative diameter for each sieve. The relationship between diameter (in form of logarithm) and accumulate weight percentage is constructed. Geometric-mean diameter and its responding standard deviation are calculated, the new multiple range test statistical method on significant analysis by D. B. Duncan is used for the determination of the stability on the diameter.

3 .Germination Test

(1).Germination percentage=$\sum A/N\times 100$ ……(2)
where A:total number of seed germination; N: total number of seed tests;

(2) Germination potential：

day^{-1} =100×(A1＋A2＋……＋An)/(A1×T1＋A2×T2＋…＋An×Tn) ……(3)

where An: Number of seed germination each day n; Tn: days following tests;

III. RESULTS AND DISCUSSION

A. Analyses of physicochemical characteristics for mushroom compost

From the results of recipe tests, EC of mushroom compost is 2.61dS/m which shows a little higher than normal value and it is bad for germination. The optimum value of C/N ratio for germination is less than 20 while the test is 23.8. The others,

Table 2 Material analysis of physicochemical characteristics for Mushroom waste compost

Items	O.M	N	P2O5	K_2O	pH	EC	C/N	G. P.	WHC	CEC
quantity	88.40%	1.71%	2.77%	0.69%	6.63	2.61 dS/m	23.8	92%	246%	56.1cmolc/kg

G.P.: Germination percentage
WHC: water holding capacity

such as O.M., N, P_2O_5, and K_2O, are within the normal ranges. All the testing results are shown in Table 2.

B. pH value of hydro seeding materials

Comparing the dried recipes with recipe 13 (no cement with pH), we find the higher the cement ratio, the larger the pH is.

C. Electrical conductivity (EC) of hydro seeding materials

From Table 3, the EC of recipe 13 is the highest with 1.340 dS/m, the others are lower than 2.8 dS/m with 5% significant level, it means cement is the most important factor for the influence to EC. Generally speaking, pH-value will

Table 3 The pH & EC value of different material treatments

Group Ⅰ	recipe 1	recipe 2	recipe 3	recipe 4
pH(F, S)	10.75, 8.32	9.32, 8.29	8.76, 8.16	8.64, 7.88
EC (dS/m)	0.975	0.971	0.937	0.903
Group Ⅱ	recipe 5	recipe 6	recipe 7	recipe 8

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pH(F, S)	9.30, 8.14	8.73, 8.10	8.68, 8.15	7.8, 7.98
EC (dS/m)	1.080	1.100	1.114	0.940
Group Ⅲ	recipe 9	recipe 10	recipe 11	recipe 12
pH(F, S)	8.77, 8.26	8.69, 8.19	8.61, 8.15	7.75, 7.63
EC (dS/m)	1.294	1.328	1.335	1.088
Group Ⅳ	recipe 13			
pH(F, S)	6.46, 6.30			
EC (dS/m)	1.340			

always be reducing after recipe dried. In table 3, pH (F,S) means the pH-value of (first time, second time) after dried.

D. Stabilities of polis oil for hydro seeding materials

The results of wet-sieve testing are seen in Table 4. The grain diameter is 0.0185 and is the smallest. The more the cement in the mixed material, the bigger the diameter of the adhesive agent is, and it will be more stable for anti-erosion.

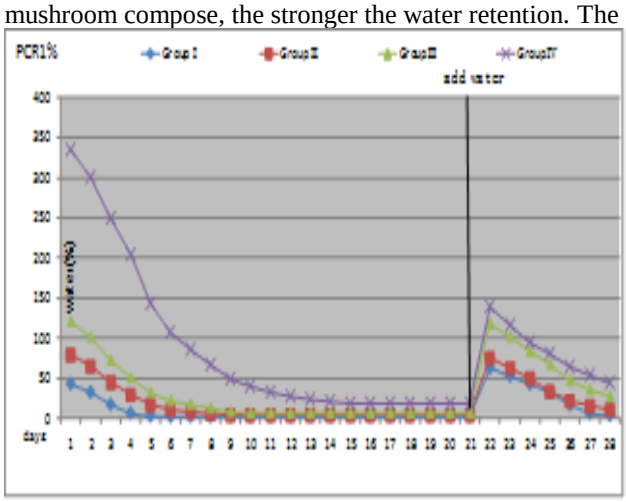
Table 4 The results of wet-sieving analysis.

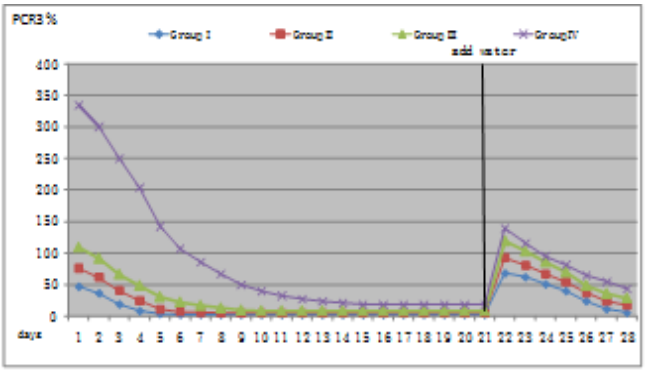
Group Ⅰ	LM dm (mm)	Group Ⅱ	LM dm (mm)	Group Ⅲ	LM dm (mm)
recipe 1	0.3115_a	recipe 5	0.2347_a	recipe 9	0.3035_a
recipe 2	0.2165_{ab}	recipe 6	0.2106_{ab}	recipe10	0.2155_{ab}
recipe 3	0.1807_c	recipe 7	0.1838_c	recipe 11	0.1871_c
recipe 4	0.1082_d	recipe 8	0.1795_d	recipe 12	0.1287_d
Group IV	0.0185				

Remark：New multiple range test (by D. B. Duncan) is used with 5 % significant level. Recipes 2, 6, 10 are the significants.
LM dm: lognormal geometric mean diameter of mixed materials

E. Water retention of hydro seeding materials

In Figure 1, the water contain is after gravity drainage of the mushroom compost, the higher the mixed material of the mushroom compose, the stronger the water retention. The





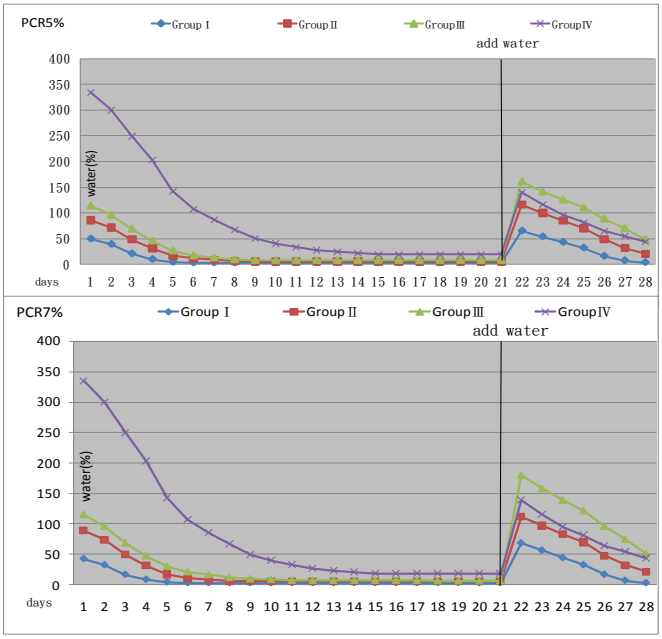


Fig 1 The water amount of different material treatments water retention is higher when cement ratio is greater than 5%.

F. Hardness of hydro seeding materials

In Table 5, the hardness is tested after the mushroom compost mixed material was made. The hardness is shown as 0.5mm~10.3mm, and it indicates us increasing cement ratio will make the hardness increased which is good for seed adhering seed with soil to be protected From the D. B. Duncan's new multiple range test，significance level 5%, the cement ratio is a significant factor for determining hardness. While the loamy sandy soil in mushroom compost can reduce the hardness to advantage of plant growth.

Table 5 The hardness of different material treatments after 60 days duration

Group \ PCR	7%	5%	3%	1%
Ⅰ	10.3_c	10.3_{bc}	4.0_{ab}	0.7_a
Ⅱ	8.3_c	3.0_{bc}	1.5_{ab}	1.2_a
Ⅲ	8.7_c	4.8_{bc}	1.3_{ab}	0.5_a
Ⅳ	20			

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Ps：Use D. B. Duncan’ s new multiple range test，significance level 5%，The same footnote alphabet means those treatments non-achieve significance level 5%.

G. The seed germination percentage for the Lolium multiflorum with various recipes

The seed germination percentage of *Lolium multiflorum* with various mushroom compost recipes in Table 6 shows the pH-value and the hardness have insignificant function but the higher ratio the cement , the less germination potential is. It means that the cement ratio has significant influence on the seed germination potential because the seed germination period is significantly postponed.

Table 6 *Lolium multiflorum* seed germination rate and germination potential of different material treatments

Group Ⅰ	recipe1	recipe 2	recipe 3	recipe 4
SGRP	90(8.9)	86(10.3)	90(12.1)	91(13.9)
Group Ⅱ	recipe 5	recipe 6	recipe 7	recipe 8
SGRP	93(11.5)	95(13.4)	100(14.0)	95(13.4)
Group Ⅲ	recipe 9	recipe 10	recipe 11	recipe 12
SGRP	94(11.7)	90(11.3)	97(14.2)	97(15.0)
Group Ⅳ	recipe 13			
SGRP	100(15.8)			

SGRP: seed germination rate and potential

Lin ([9]) has done the vegetation effect and succession analysis of mixed medium used on hydro-seeding - case study on the slope land of Jhuo-she forest road, good results are found.

IV. CONCLUSIONS

In this paper, cement, and loamy sandy soil are used with mushroom compost in various ratio to progress the physicochemical property analysis in order to find the optimum situations for seed germination and the anti-erosion of the slope land. And we have the following conclusions:

- The cement ratio is a significant factor for determining hardness and pH value. While the loamy sandy soil in mushroom compost can change the physical property of soil and reduce the hardness to advantage of plant growth.
- The larger the cement ratio, the larger of the diameter for the adhesive agent is.
- The EC value has be strongly affected by the loamy sandy soil ratio which will influence the seed germination. The higher the loamy sandy soil ratio, the larger the EC value is.
- The more volume ratio the mushroom compost, the larger the water retention is.

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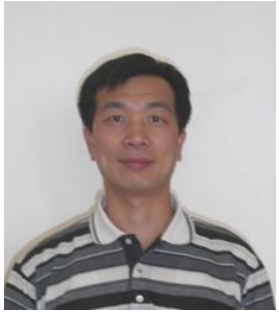

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