

Effect of amending green manures and herbicide pendimethalin on soil microbial communities

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Introduction

Weeds grow very fast in a subtropical zone, like Taiwan. Therefore, herbicides are widely applied for weeds control. In addition, green manures have been used to reduce the amount of chemical fertilizer recently. However, the effect of herbicide and green manures amended on soil bacteria community were rarely discussed.

Objectives

In this study, Biology Ecoplate™ was used to examine the effect of herbicide pendimethalin on soil microbial diversity. In addition, the microbial community change in soil with or without green manures amended was also studied.

Methods

- ◆ Incubation experiment - soil samples with air-dried and sieved were put in plastic tank then added distilled water to field capacity. Pendimethalin that was dissolved in acetonitrile added to pre-cultured soil and made final concentration to 25.5 ppm. Green manure treatment was added 16 g fresh lupin or cosmos with minced. All treatment were triplicated and cultured with field capacity at 28°C for 110 days.
- ◆ Biolog Ecoplate test- soil sample added sterilized water shack at 120 rpm for 1 hour. Centrifuge and put the suspension into 96 wells plate. The plate will culture at 25°C for 72 hours. Use 595 nm to evaluate the absorbance by microplate reader. To standard the absorbance and calculate the value of average well-color development (AWCD). The program of AWCD is as follow :

$$AWCD = \frac{\sum_{i=2}^{N=96} (OD_{595}^N - OD_{595}^1)}{95}$$

Standardized these data and to principle component analysis (PCA) by using statistical software.

Results

- ◆ Total carbon content and total nitrogen in lupin was more than cosmos and the CN ratio in lupin and cosmos was 12.62 and 17.66 (Table1).

Table 1. The properties of the soil after amending plant materials incubated for 110 days

Properties	(Sankengtzu soil , Sk soil)		
	Pre-culture	lupin amended	cosmos amended
pH (H ₂ O)	5.2	5.5	5.1
CEC (cmol(+) kg ⁻¹)	3.06	4.06	4
TOC (g kg ⁻¹)	6.68	6.89	20.08
Total N (g kg ⁻¹)	0.46	0.47	0.5
Exchangeable cation			
K (g kg ⁻¹)	6.44	9.58	17.83
Ca (mg kg ⁻¹)	41.12	44.66	59.2
Na (mg kg ⁻¹)	2.09	6.77	7.89
Mg (mg kg ⁻¹)	5.2	5.2	7.78

- ◆ Microbial communities with pendimethalin applied after 24 hours were differ from blank, and green manures amended revealed the same effects(Fig 1.). The microbial communities in green manure amended microbial communities was recovered after 110 days(Fig 2.). Green manure amended could not recover the effect of pendimethalin on microbial communities(Fig 3.). The activity of microorganisms in lupin treatment was higher than cosmos treatment after 24 hours and 110 days. However, activity of microorganisms at the 110th days was lower than 24 hours on lupin or cosmos treatment.(Fig4.)

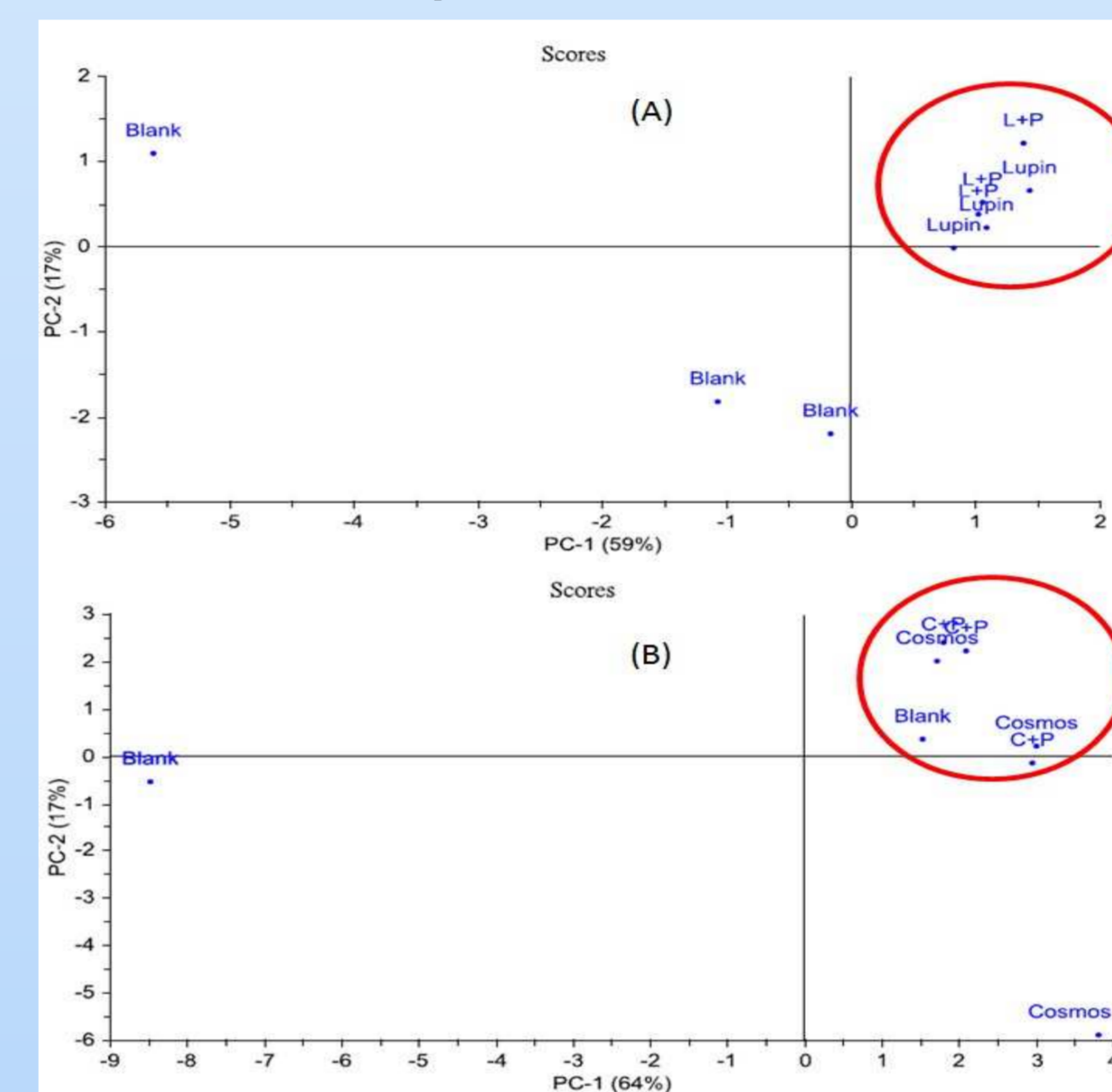


Fig1. .Principal components analysis on soil microbial communities from Sk soil with different treatments after 24 hours. (A)amending lupin (B) amending cosmos.

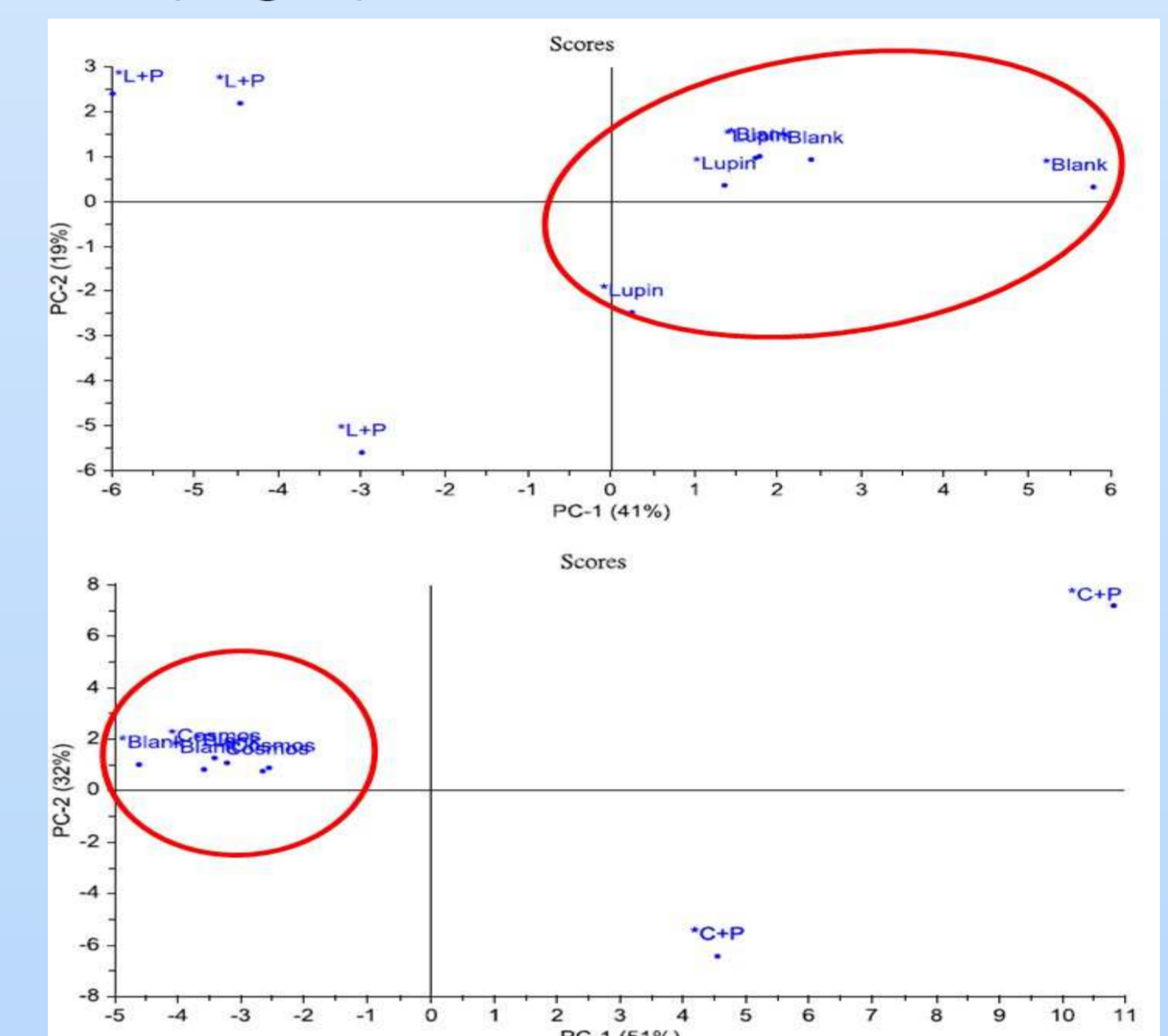


Fig2. Principal components analysis on soil microbial communities from Sk series soil with different treatments in 110th day. (A)amending lupin (B)amending cosmos

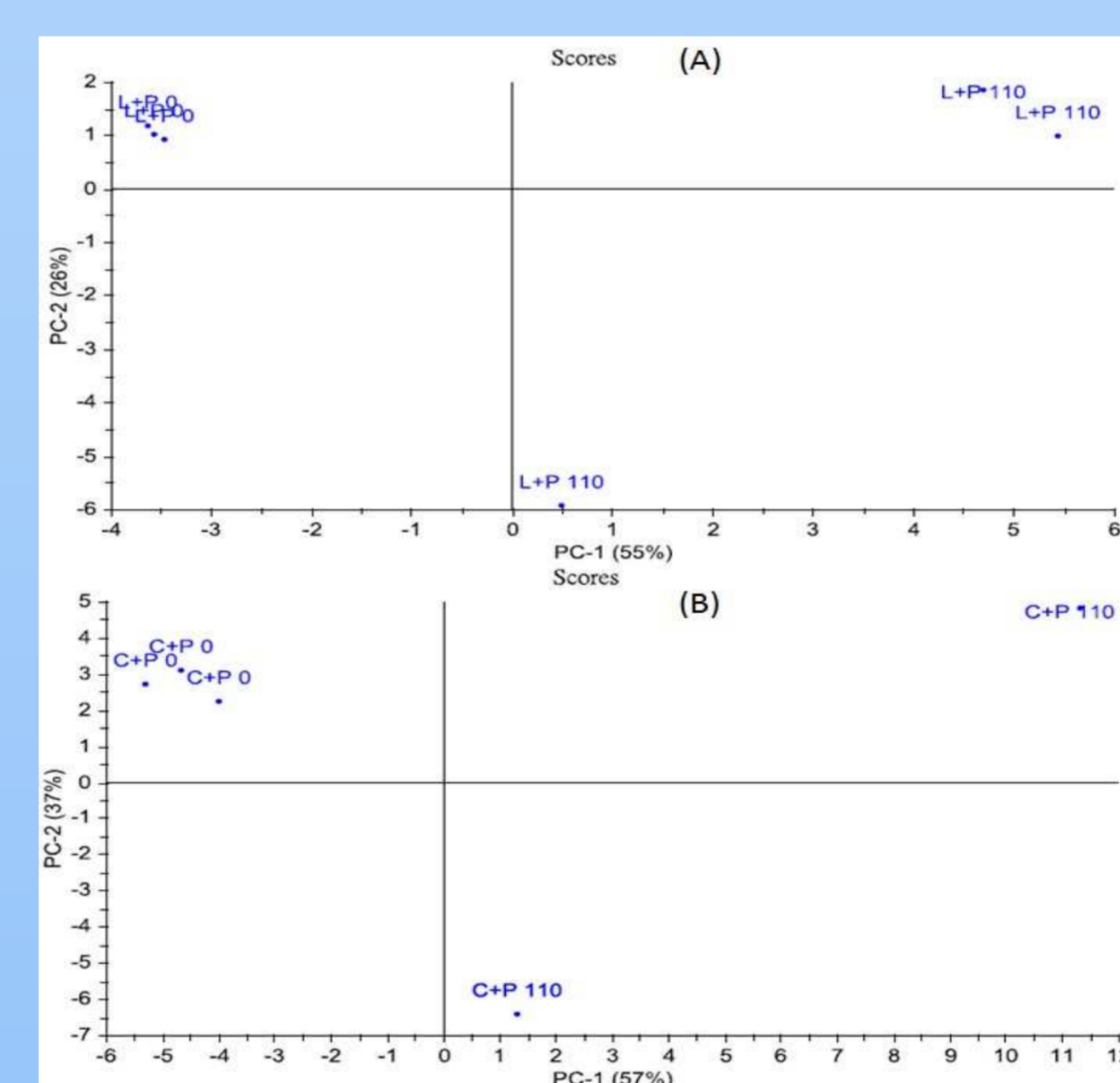


Fig3. Principal components analysis on soil microbial communities from Sk series soil with different treatments in 110th day. (A)amending lupin (B)amending cosmos

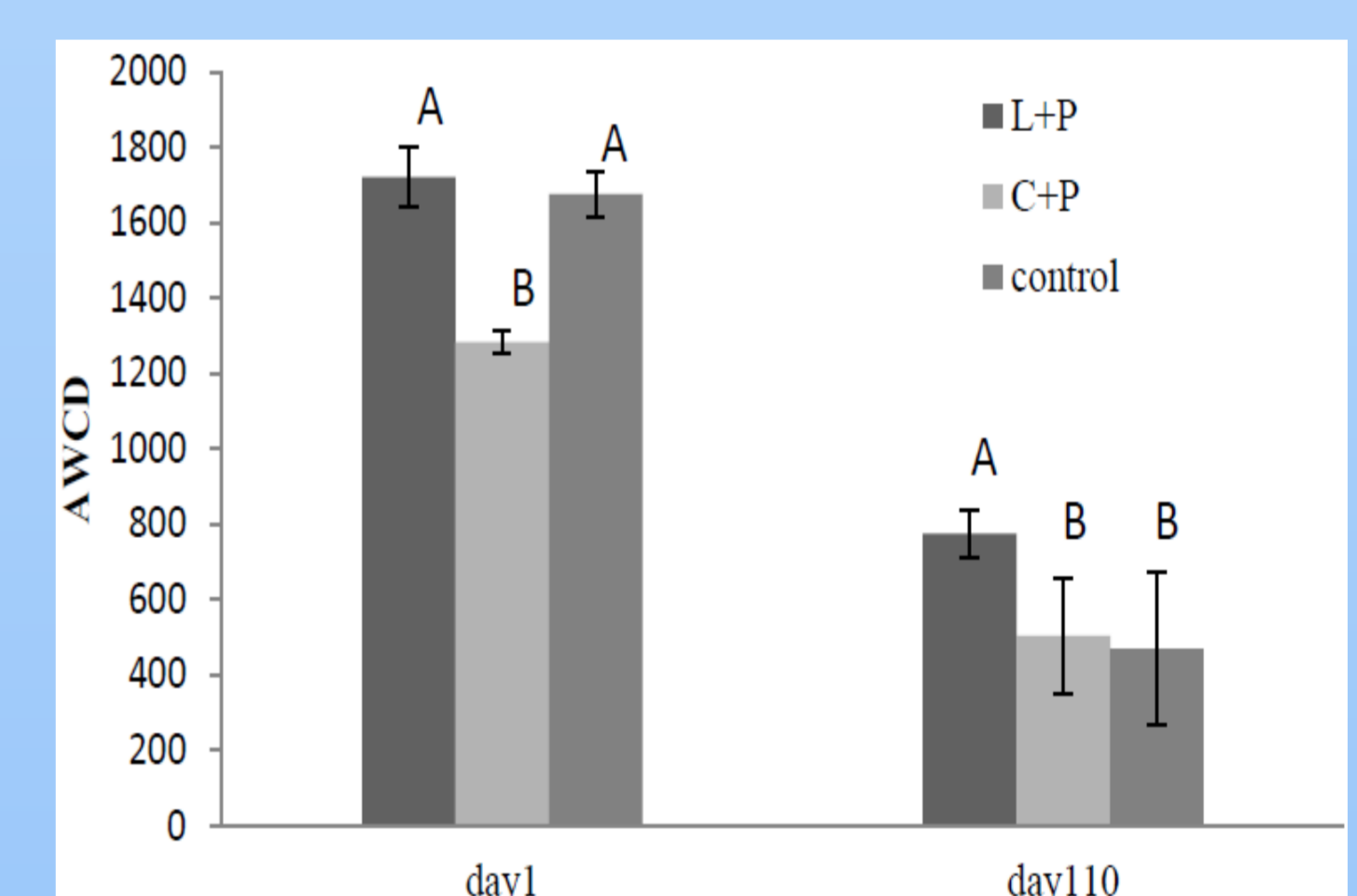


Fig4. Average well-colorevelopment (AWCD) of Sk soil with different treatments. L+P is pendimethalin in lupin amended soil ; C+P is pendimethalin in cosmos amended soil.(Duncan ; p<0.05)

Conclusion

Lupin is a better green manure than cosmos because more nitrogen in lupin could promote microorganism growth. In addition, pendimethalin and green manure amended would affect microbial communities in SK soil. Green manure amended could not recover the effect of pendimethalin on microbial communities. On the other hand, green amended could increase activity of microorganisms and improve pendimethalin degraded, but the activity of microorganisms after 24 hours was higher than the 110th day on green amended soil.