Management of Weeds through the Application of Effective Microbes

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Abstract : *A study was conducted to evaluate the influence of effective microorganisms (EM) as a possible alternative to the use of chemical herbicides to control weeds. Treatments consisted of EM-1, molasses and urea mixed with purified water at different proportions. The amount of NH_3 produced, pH, TIBA, organic acid and microorganisms in the treatments were monitored. Results show that compared to glyphosate weedicide popularly used the fermented liquid added to EM, molasses and urea with aeration were able to control weed growth. It was an environmentally safer method as well.*

Introduction

Currently almost all farmers produce vegetables and fruits and use a lot of pesticides and commercial fertilizers. However, it is known that this type of chemical farming continuing around the world is causing and will continue to cause many kinds of ecological and health problems. Some well-known adverse effects of chemical farming are : 1) diversity and balance of soil microorganisms decrease, 2) soil pests increase, 3) soil fertility decreases, and pollution of environments and pollution of ground waters occurs. In this experiment a weed killing fermented liquid, made using effective microorganisms (EM) technology was evaluated as a replacement for chemical herbicides.

Materials and Methods

Experiment 1

The materials used were EM-1, molasses, urea, purified water and lime. The materials were mixed and cultured according to the following six different treatments.

Treatment	Materials (% by volume) mixed purified water	Culture method
1	EM-1 1%, molasses 3%, urea 1%	Aeration (by air pump)
2	EM-1 1%, molasses 3%, urea 1 %	Anaerobic (lid closed)
3	EM-1 1%, molasses 3%, urea 1%, lime 0.1%	Aeration (by air pump)
4	Molassses 1%, urea 1%	Aeration (by air pump)
5	EM-1 1%, molasses 1%	Aeration (by air pump)
6	Urea 3%	Aeration (by air pump)

To monitor the characteristics of each fermented liquid the following parameters were measure : pH, NH_3, yeast count, lactic acid bacteria count, acetic acid bacteria count, TBA (lipid peroxide), and various organic acids. pH was measured daily by Shindengen ISFET. pH Meter KS701 for 17 days. NH_3 was measured daily by gas sensor GASTEC GV-100S for 17 days consecutively. Microbial population of yeast, lactic acid bacteria, and acetic acid bacteria by plate count method (three range x three replications per medium). Each culture medium was made reference for appendix. The following organic acids were measured: lactic, acetic, propionic, butyrid, and valeric. A sample of the fermented liquid was measured by Shimazu HPLC LC-10, and extraction was measured by the method of Ueda U-ryukyu. EM fermented material at antioxidant affect.

TBA was measured by the method of Kosugi and Kikugawa (1985).
The experiment that different concentration of urea was measured NH_3 and pH. Mixed with EM1% and molasses 1%. Then each urea 1%, 3%, 5%, 10% were added to the solution, and measured pH and amount of NH_3.

Experiment 2

Weed Control in Trays

Fermented liquid treatment 1 was used to observe the effect on weeds in this experiment because it had the highest NH_3. 40 ml of the liquid was sprayed to half of the tray of each weed species.

Soil used was Shimagrimargi at Okinawa soil. The parting medium consisted of 50% Shimagrimargi and 50% compost. The Okinawa soil was passed through a 9 mm screen. Weed used were Edelia, Dallisgrass, and Beggar's tricks. These species are common weed problems in Okinawa. Wedelia that grow along the seashore in Okinawa and has salt tolerance and herbicide tolerance, and Dallis grass also has herbicide tolerance.

The weed was cut and the terminus growing fastest and the cottage growing well was used.

At the part of fermented liquid was treatment 1 (10 days after) that most increased NH_3. Then this was sprayed half of tray at 40 ml. As a control ammonia solution (28%) was used. Because it contains NH_3. This was used to observe the effects of NH_3 with the microbial populations.

Results

Amount of NH_3 produced by each treatment is shown in Figure 1. Treatments 1, 3 and 4 detected NH_3. In treatment 1 the amount of NH_3 increased suddenly. Treatment 2, which contained same ingredients as treatment 1, but without aeration, did not produce a detectable NH_3. Therefore when the fermented liquid was cultured using EM1 and molasses under aerobic condition, NH_3 was generated. All treatments containing NH_3 has weed killing effects.

Figure 2. shows the pH of each treatment over time. The pH of treatments 2 and 5 suddenly dropped after approximately 2 days. It stabilized around 4.0. The dropping pH is believed to be caused by an increase in organic acid produced by lactic acid bacteria. However, the pH of treatments 1, 3 and 4 rose. In particular, treatments with aeration had a noticeable rise in pH after approximately 2 days.

Table 1 shows TBA results. The highest TBA and aldehyde condition were aerobic section. Figure 3. shows amount of organic acids. All treatments presented organic acid. Especially anaerobic condition was the most organic acid, like lactic acid, acetic acid, and propionic acid. Molasses section did not present lactic acid, but large number of acetic acid. Butyric acid when became organic matter decayed and was not detected.

Table 1. TBA at Each Treatment

	TBA nmol MDA/ml	Aldehydes nmol/ml
EM 1% molasses 1% air	23.93162393	120.4959883
EM 1% molasses 1% after urea added	4.316239316	64.18672502
EM 1% molasses 1% urea 3% air	10.36324786	63.82202772
EM 1% molasses 1% not air	5.384615385	28.51932896

Table 2 indicated cultivation for fermented liquid at 10 days after. Anaerobic section was most amount of lactic acid bacteria, acetic acid bacteria and yeast. On the other hand, these microorganisms existed in the aerobic section which was pH 9.5.

Table 2. Microorganisms in Fermented Liquid

	Lactic acid Bacteria (10^{-5})	Acetic acid Bacteria (10^{-5})	Yeast (10^{-3})
Treatment 1	80.3	47.5	
Treatment 2	700	565	
Treatment 4	0.53	48	

In the experiment 2 weed killing effect was investigated at fermented liquid. Weed was used at Wedelia, Dallisgrass and beggar's ticks. And fermented liquid was sprayed at 40 ml to half tray of weed. Result showed weed was restricted for their growing. Especially Wedelia of Composite family scorched their leaves.

Discussion

The object of this experiment was to make a new weedicide that did not destroy environment. Treatment 1, 3 and 4 made weeds growing respect. In these treatments NH_3 were detected. But others did not. Ammonic gas was hight. Also treatment 6 which include urea 3% with aeration did not detect NH_3. This result meant that urea wad degraded by microorganisms and released NH_3. And NH_3 and weed kiling effects had some relationships.

Compared with treatments 1 and 4, treatment 1 had more weed killing effects and acted faster because treatment 1 contained effective microorganisms and they degraded most urea to NH_3 (Table 1).

It is known that microorganisms produced organie acids when they degraded molasses like glucose and sucrose. So treatment 2 had the most of organic acids, because fermentation occurred under anaerobic conditions. It detected lactic acid, acetic acid, and propionic acid. But in this experiment treatments 1 and 4 also detected organic acid slightly. It is well known that organic acids promoted the leaves to absorb minerals. So it may be thought that both organic acid and NH_3 made weeds kill.

Table 2 indicated cultivation for fermented liquid at 10 days later. Microorganisms of fermented liquid were same result as amount of organic acids. Treatment 2 had the most number of microorganisms, like lactic acid bacteria, acetic bacteria, and yeast. Also

treatments 1 and 4 had microorganisms. The existence of microorganisms in these fermented liquids showed that these liquids may be safe, and do not contaminate soil and ground water. The experiment of TBA and aldehydrate was expected that it had indicator of weed killing effect because of its free radical reaction. But in this experiment, these effects did not increase.

Weed-killing test in tray, showed all weeds were restricted in their growth. Especially Wedelia and beggar's trick leaves were scored only one day. The fermented liquids containing EM restricted these three weeds and in the field many weeds were restricted. So here after, we will try to find how much water was added to fermented solution to diluent.

Accordingly the fermented liquid added to EM, molasses, and urea with aeration were able to restrict weed growth. Compared with glyphosate weedcide that were popular and generally used, it was quick to kill weeds and safe for environment. Moreover it was made very cheaply. Through the timing of spraying it, method, concentration and effect of seed are still unresolved.

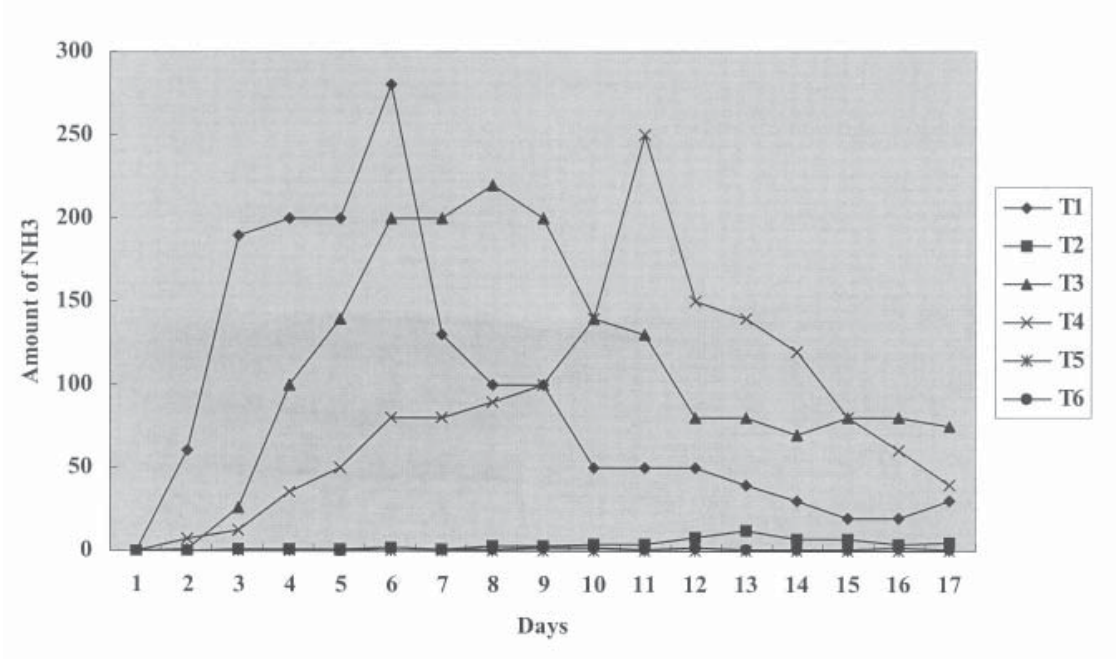

Figure 1. Amount of NH_3 Produced in Different Treatments

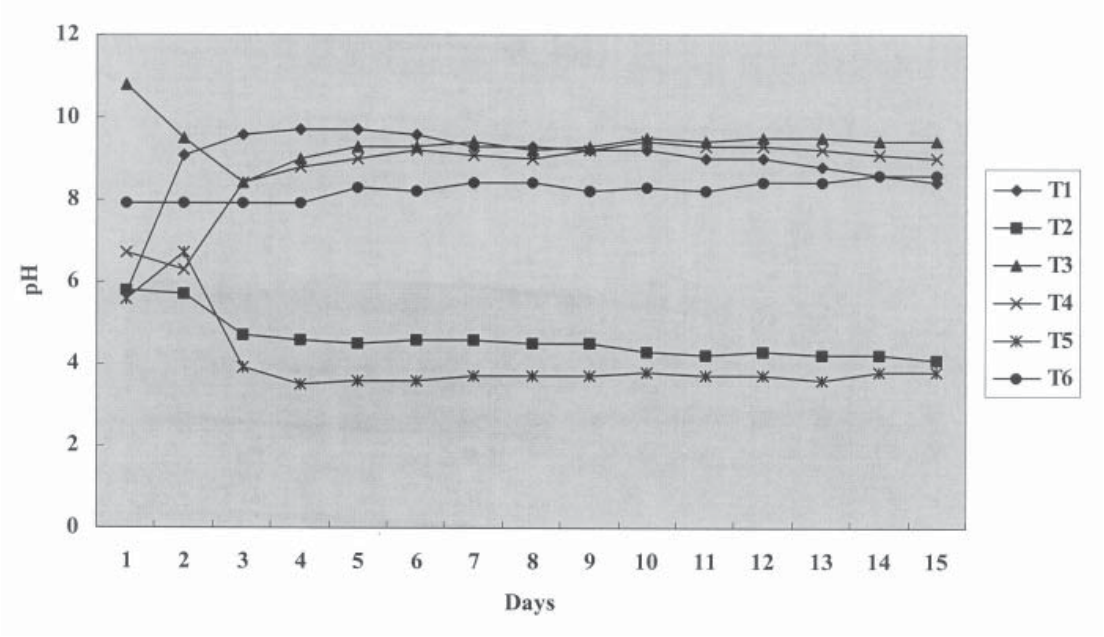

Figure 2. Levels of pH in Different Treatments

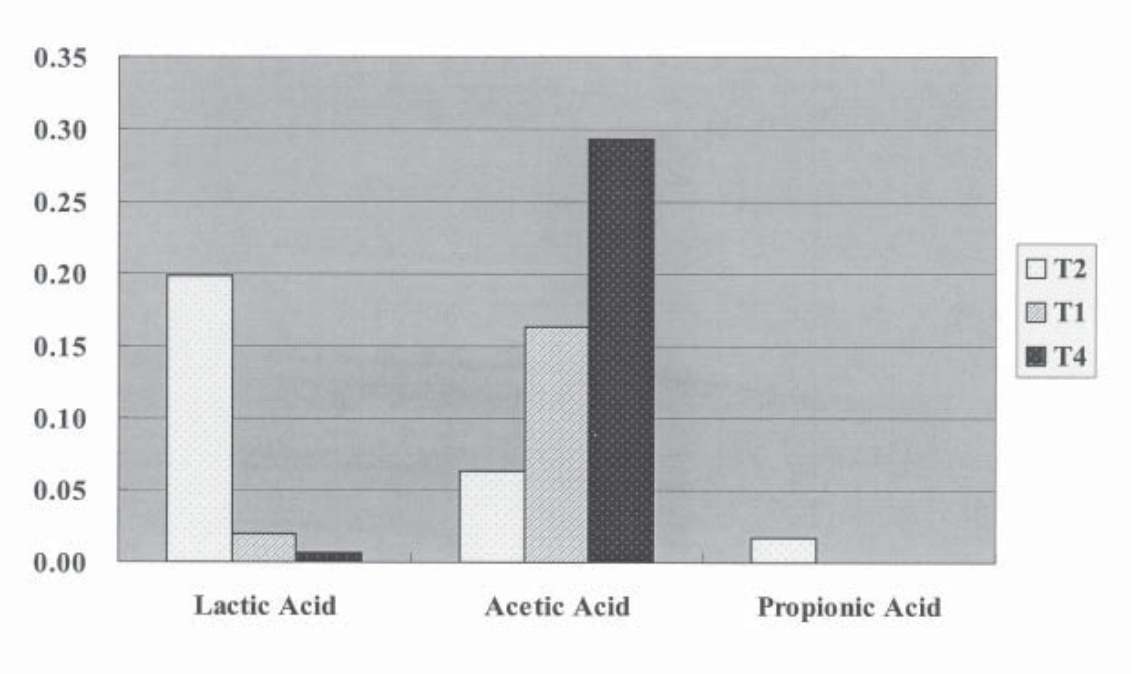

Figure 3. Organic Acid Levels in Treatments