Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
ISSN Online 2286-1580, ISSN-L 2285-5653

EVALUATION OF POTENTIAL BIODEGRADATION OF MATERIALS BASED ON PEAT AND WASTE OF CELLULOSE FIBRES FOR USE IN SEEDLING PRODUCTION

Elena DOBRIN[1], Mihaela ROȘU[1], Elena DRAGHICI[1], Petronela NECHITA[2]

[1]Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine from Bucharest, Marasti 59, District 1 011464, Bucharest, Romania,
E-mail: edobrin_usamv@yahoo.com
[2]Ceprohart S.A., Braila, Al. I. Cuza, Email: petronela.nechita@ceprohart.ro

Corresponding author email: edobrin_usamv@yahoo.com

Abstract

In order to develop a flexible production technologies nutritive biodegradable pots that easily adapt to culture plant requirements and the environmental protection have been tested in terms of biodegradation capacity following types of fibrous materials: natural wood cellulose, cellulose bleached softwood, softwood mechanical pulp, waste, corrugated cardboard, waste paper from newspapers and magazines mixed, with variations of compositions consisting of mixtures of cellulose waste and peat. Research developed in a PNCDI 2 researches program has revealed that the biodegradation potential of the tested samples is very different, from 20% in softwood mechanical pulp to 57% to natural wood pulp. Using the peat in the composition samples resulting slowing their biodegradation in soil. In terms of ability to develop an environment for root growth and development, of all samples can be recommended for introduction into the test as biodegradable pots, between the degree of cellulose degradation and the intensity of specific microflora respiration there is a direct positive correlation very significant.

Keywords: *biodegradation, cellulose waste, peat, pots, seedling*

INTRODUCTION

Cellulose is a major constituent of plant materials and the most abundant organic material present in nature, the main source of carbon and energy for soil microflora and is degraded only by microorganisms capable of producing cellulases [5]. In general, organic substances of plant origin have a high resistance to biological degradation. It develops slowly and usually requires intervention of a large number of microorganisms, so that there are over 200 species of microorganisms that produce cellulases and their ability to degrade cellulose. Therefore, in recent years, cellulose was introduced as a prop for carrying out different types of biodegradable pots used in the production plant production of container plant material. Develop new biodegradable products based on peat, cellulose and other supplements protective and stimulating Romanian design, for use for making pots to support crop production, in general, and horticultural production, particularly is a priority for research. Solving this problem would allow development an alternative technology, bio, for containerized seedlings for horticultural production. The purpose of this research was to characterize different materials based biocomposites peat and waste cellulose and identifies the most suitable recipes, in terms of their ability to develop an appropriate culture medium of microorganisms respectively, plants. The research was part of a comprehensive research program PNCDI-2, contact BIOSUN 51-090.

MATERIAL AND METHOD

Research has been conducted in the laboratories of the Faculty of Horticulture - University of Agricultural Sciences and Veterinary Medicine, Bucharest. Have been studied several types of waste cellulose, singly or in combination with peat KEKKILÄ - BP. Results of previous research recommends this type of peat as a good material for making nutritive biocomposites pots [1].

Variants of samples studied were as follows:
1. softwood mechanical pulp (PM);
2. 25% cellulose bleached softwood (R) + 75% KEKKILÄ – BP peat (T75);
3. 50% cellulose bleached softwood (R) + 50% KEKKILÄ – BP peat (T50);
4. waste paper from newspapers and magazines (MZ);
5. waste from corrugated cardboard (MO);
6. cellulose bleached softwood (R);
7. natural wood cellulose (N);

These samples were tested in terms of biodegradation potential by determining the cellulose decomposition - adapted from the method for determining cellulozolytic activity in soil [4, 5, 1, 2, 3] and in terms of ability to develop a favorable environment for the installation of the microflora specific to the soil and growing substrate by determining the intensity of respiration microflora involved in the cellulozolytic material decomposition - Ştefanic method adapted from Unger - quoted Szegi [4, 5, 6]. Adaptation of the two methods work consisted in the fact that different variants of working, with equal areas and weights determined were placed in a nutrient substrate, suitable for producing seedlings, placed in plastic pots of 0.5 l capacity. In advance samples were weighed and dressed in a plastic lycra bag of the known weight with the role of preservation of organic matter biodegraded [1, 2, 3]. Samples thus prepared were kept in a small home of vegetation at 24-26^{o}C, a constant humidity of 60-70% of the substrate, for 14 days. After this period was done as follows: bag of pot was removed, washed in running water, then was dried in an oven for 4 hours at 105^{o}C and weighed.

The degree of cellulose degradation was calculated as:

% cellulose material decomposed $= \frac{Gi - Gf}{Gi - Gs} x100$

Gi - sample weight + weight bag before they enter into the pot

Gf - sample weight + weight bag after being removed from the pot

Gs - bag weight

RESULTS AND DISCUSSIONS

Cellulosic materials studied have varying degrees of decomposition (Table 1). Although cellulose is an organic compound with a slow decay in nature, in our case the materials used were degraded at a rate of 20.37% -57.2% after only 14 days, during which they were kept in optimal conditions for growth and development of cellulozolytic microorganisms (humidity, temperature, and nutrient substrate - peat). We should mention here that in the assessment of the degree of decomposition of cellulose substrate is used as a pure substance or in our study worked but not with cellulose cellulosic substances with other organic compounds which printed different characteristics of studied materials specific to practical purpose use, namely making of pots used in the production of vegetable seedlings.

Table 1. Biodegradation potential of biocomposites materials

No.crt.	Cellulosic material	Biodegradation potential (%)	Observation
1	PM	20,37	The material hadn't been disintegrated
2	T75	27,09	The material hadn't been disintegrated, but some small pieces had detached
3	T50	45,53	The material had been disintegrated in cca. 50%
4	MZ	40,32	The material had been disintegrated in big and small pieces
5	MO	41,71	The material hadn't been disintegrated but some small pieces had detached
6	R	54,78	The material had been disintegrated
7	N	57,20	The material had been disintegrated, but not all

Breathing activity is an indicator which highlights global biological activity of the substrate. Unlike natural habitats where many species are represented by a relatively small number of individuals in habitats where they are introduced substances or substrate, proliferation is favored species able to use it as energy source. Therefore in this study presumably cellulozolytic microflora is stimulated, one equipped with complex enzyme capable of degrading cellulose substances introduced as a substrate in the form of cellulosic materials. According to the results presented in Table 2 can be seen that the introduction of cellulosic materials has led to increased activity of the microflora breathing between 21.51 to 151.10 mg g CO2/100 substrate, which means an increase of 0.5 to 4.75 times higher than the simple peat, which was the work of breathing characteristic of this habitat. The largest increase in respiration activity was recorded in bleached softwood pulp natural (191.35 mg CO2/100 g substrate). This is followed by bleached softwood pulp (189.42 mg CO2/100 g peat). In samples where bleached softwood pulp was mixed with peat potential biodegradation decreased with increasing percentage of peat, something reflected in the breathing of the microflora. The lowest stimulating breathing activity was determined by the pine wood mechanical pulp (PM).

Table 2. Microflora breath involved in the breakdown of the cellulosic material

No.crt.	Variant	mg CO_2/100 g substrate	Differences from control	
			mg	%
1	PM	61,76	21,51	153,44
2	T75	99,26	59,01	246,60
3	T50	126,28	86,03	313,73
4	MZ	100,91	60,66	250,70
5	MO	126,83	86,58	315,10
6	R	189,42	149,17	470,60
7	N	191,35	151,10	475,40
8	control	40,25	Mt	100

From Fig. 1 we can see very strong relationship between the degree of decomposition of various cellulosic materials studied and the breathing of the microflora of the habitats where they were introduced as energy substrates.

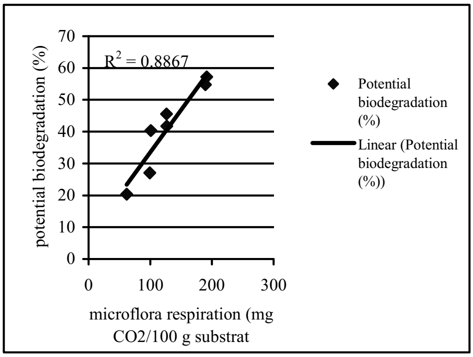

Fig. 1 Influence of sample composition on the degree of biodegradation and the specific microflora respiration

CONCLUSIONS

Biocomposites materials studied had extremely different biodegradation potential.

Lowest biodegradation potential was recorded in softwood mechanical pulp (PM) - 20.37%, while the natural wood cellulose (N), biodegradation was intense, more than 57%.

Waste paper from newspapers and magazines (MZ) and waste from corrugated cardboard (MO), can be categorized as having medium potential for biodegradation (40-42%).

Addition of peat in the bleached softwood pulp leads to lower degree of decomposition, with implications for physical integrity of the material studied for a long period of time.

Between the degree of cellulose decomposition and involved microflora respiration intensity level in the breakdown cellulosic material is a positive correlation direct, highly significant.

REFERENCES

[1] Nechita Petronela, Elena Dobrin et all., 2007. *Biocomposites from renewable resources – biodegradable nutritiv supports for containerized seedling manufacturing*. National Research Programme, BIOSUN, contract no. 51-090, stage 1/2007

[2] Nechita Petronela, Elena Dobrin et all., 2010. *Biodegradable pots for planting*. BioResources 5(2), p. 1102-1113, www.bioresources.com

[3] Stanciu Florentina, 2011. *Cercetări privind noi sisteme de producere a răsadurilor de legume*. Teză de Doctorat, USAMV Bucureşti, Bucureşti, p. 194-245

[4] Ştefanic G., 1999. *Probleme de agrofitotehnie teoretică şi aplicată*. Vol XXVIII, supliment, p. 45-50

[5] Ştefanic G., Săndoiu D.I., Gheorghiţă Niculina, 2006. *Biologia solurilor agricole*. Ed. Elisavaros, Bucureşti

[6] Szegi J., 1988. *Cellulose decomposition and soil fertility*. Akademiai Kiado, Budapest, p. 65-68

EX·TERRA·AVRVM