

INFLUENCE OF THE POLYMER BURIED IN SOIL ON THE PLANTS' GROWTH II. POLYETHYLENE/LIGNIN AND POLYETHYLENE/CELLULOSE BLENDS

MIHAELA M. MACOVEANU*, PROFIRA VIDRAȘCU**,
MIHAELA CRISTINA PASCU*, LENUȚA PROFIRE*, GEORGETA ȚAZACU*,
I. MANDRECI*, H. DARIE*, CORNELIA VASILE*

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Abstract: The culture of the *Vicia x Hybrida* hort. in a soil containing polyethylene/lignin or polyethylene/cellulose blends both the greenhouse and natural conditions has been followed. The vegetative mass, pigments and blooming were richer, when higher lignin content was. In natural conditions the influence of blends on the plants' growths was less important.

Introduction

Polyethylene (PE) show high resistance against photo- and biodegradation. One of solutions to transform them in friendly environmentally materials and assimilation in natural cycles consists in the manufacture of several products from the blends of PE with natural polymers, as starch, cellulose or lignin, and their derivatives. Relatively ease biodesintegration/deterioration and biodegradation of such blends leads to the diminution of the generated waste quantity (especially packaging and agriculture film).

Experimental

PE/ammonium lignosulfonate (PE/LSA) or calcium lignosulfonate (LSCa) blends have been obtained by extrusion and roll-mill-press methods, the mixing ratios being shown in the following tables. In several blends an ethylene/vinyl acetate (EVA) copolymer, as

*Institutul de chimie macromoleculară „Petru Poni” Iași
**Grădina Botanică „Anastasia Fătu” Iași

compatibilizing agent has been used. [1, 2]. A quantity of 6-10 g blends has been buried in soil in greenhouse (g) or natural (n) conditions. Very close to the polymer specimens, the seeds of *Vicia x Hybrida* hort. (with the 80-100% germination) have been plant. The plants growth has been followed by the well-known methods [3].

Results and discussions

The blends samples showed after one year period some superficial modification. The natural polymer (LSA, LSCa and cellulose) particles distributed in PE become swollen by water. For an amount higher than 10% natural polymer, the water absorbed in very higher in the disintegration is evident, several samples showed an increased weight loss.

The influence of the presence in soil of the polyethylene blends and the envolved products by degradation/hydrolysis can be appreciated on the basis of the data summarized in the tables 1-3.

The most plants grown in soil with buried blends. Vegetative mass was increased in respect to reference plant (no PE / lignin blends in soil) (Tab. 1), but the differences in the dried mass being insignificant. It is seems that the blooming is slowly decreased. Also, the inorganic content (ash) is low.

For lignosulfonate or cellulose content below 8-10% no unfavorable influence on the chlorophyll or carotenoidic pigments has been observed, all values being close to those of reference plant (Tab. 2). Although at a high lignin content (20-30%), degradation/disintegration products of the blends seems to exhibit a negative influence both greenhouse and natural conditions. That should mean that a certain period of time the physiological state of plant is perturbed.

The amount of magnesium, cooper and iron decreased with the increase of the lignin content of the blends buried in the culture soil employed in the greenhouse conditions. No such an influence was observed in the field conditions.

References

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Table 1

Dynamics and data related to *Vicia x Hybrida* hort plants' growth. Greenhouse (g) (27.04.1996 - 7.06.1996) and natural (n) (10.05.1996 - 18.09.1996) conditions. PE / Cellulose and PE / lignosulfonates blends were buried in the culture soil

No.	Blend buried in the culture soil	Xm Average height (cm) after				Plant mass / plants height g/cm	Dried mass / % of crude mass at 50 days	Dried mass / % of crude mass at 132 days	Final dried mass	Lig- nin (%)	Blooming		Fruits	
		14 days	30 days	50 days	132 days						Heig ht (cm)	No. of buds	No. of fruits	Fruit mass
1g	Reference plant	15	68	82	-	0.21	11.1	12.5	2.0	20.3	52	50	-	-
2g	PE	14	64	83	-	0.23	9.3	13.8	2.7	21.0	35	26	-	-
3g	PE/Cellulose	12	57	78	-	0.23	10.5	12.7	2.2	17.5	37	51	5	3
4g	PE/8%LSA	19	72	102	-	0.14	7.8	11.6	2.6	20.7	67	64	-	-
5g	PE/8%LSCa	15	74	108	-	0.22	9.7	12.1	2.7	17.6	83	68	5	4
6g	PE/10%LSA	14	69	112	-	0.19	10.1	12.3	2.7	19.6	67	64	-	-
7g	PE/10%LSCa	16	72	104	-	0.16	8.9	11.4	2.3	20.1	61	64	-	-
8g	PE/10%LSAE	18	72	110	-	0.17	10.6	13.2	2.5	21.0	57	49	-	-
9g	PE/10%LSCaE	20	85	119	-	0.13	9.1	11.5	1.7	20.5	55	53	-	-
10g	PE/EVA/20%LSA	16	76	115	-	0.25	9.3	12.8	2.7	20.5	46	38	-	-
11g	PE/EVA/30%LSA	19	71	100	-	0.21	9.4	11.8	2.9	19.7	44	42	-	-
12g	PE/EVA/S/20%LSA	19	73	106	-	0.19	9.6	11.8	2.4	21.5	45	54	-	-
13n	Reference plant	11	31	52	83	0.51	12.5	32.0	12.0	24.7	40	30	10	5
14n	PE	7	31	60	101	0.44	13.4	32.5	15.7	24.7	24	26	-	-
15n	PE/Cellulose	15	40	59	95	0.31	13.0	31.5	13.0	24.0	32	26	15	19
16n	PE/EVA/20%LSA	11	39	62	111	0.73	14.4	31.1	12.3	23.1	32	31	8	8
17n	PE/EVA/S/20%LSA	15	47	68	95	0.41	17.9	32.9	16.0	23.1	30	27	11	7.5

Table 2
The chlorophyll and carotenoidic pigments content of the *Vicia x Hybrida* hort.
growth in the presence of PE/LS blends

No.	Blend buried in the culture soil	Chlorophyll Chlorophyll a	Pigments (%) Chlorophyll b	Total Chlorophyll Pigments (%)	Carotenoidic Pigments (%)
Greenhouse conditions					
1.	Reference plant	0.042	0.079	0.122	0.007
2.	PE	0.073	0.137	0.210	0.007
3.	PE/Cellulose	0.092	0.167	0.259	0.009
4.	PE/8% LSA	0.060	0.110	0.170	0.008
5.	PE/8% LSCa	0.070	0.128	0.198	0.009
6.	PE/10% LSA	0.083	0.152	0.235	0.009
7.	PE/10% LSCa	0.073	0.137	0.210	0.009
8.	PE/10% LSAE	0.069	0.129	0.198	0.008
9.	PE/10% LSCaE	0.054	0.101	0.155	0.008
10.	PE/EVA/20% LSA	0.090	0.165	0.255	0.007
11.	PE/EVA/30% LSA	0.042	0.079	0.121	0.004
12.	PE/EVA/S/20% LSA	0.051	0.094	0.145	0.005
Natural (Field) Conditions					
13.	Reference plant	0,098	0,178	0,276	0,0065
14.	PE	0,097	0,178	0,274	0,0120
15.	PE/cellulose	0,071	0,129	0,201	0,011
16.	PE/EVA/ 20% LSA	0,108	0,197	0,305	0,005
17.	PE/EVA/ S/ 20% LSA	0,095	0,175	0,270	0,004

Table 3
Mineral Content of the *Vicia x Hybrida* hort. grown
in the presence of the PE/LS blends buried in soil

No	Blend buried in Culture soil	Mineral Content (%)	Macroelements (mg/100g dried mass)			Microelements (mg/100g dried mass)			
			Na	Ca	Mg	Fe	Mn	Cu	Zn
Greenhouse conditions									
1.	Reference plant	10.3	632.7	278.6	86.2	0.28	0.38	0.37	1.73
2.	PE	7.2	1059.1	299.2	75.2	0.41	1.28	0.78	0.97
3.	PE/Cellulose	10.4	620.1	210.0	80.1	0.20	0.37	0.21	0.92
4.	PE/8% LSA	13.2	927.5	179.8	54.9	0.09	0.45	0.03	0.18
5.	PE/8% LSCa	10.3	533.8	203.8	62.4	0.09	0.36	0.02	0.17
6.	PE/10% LSA	9.9	909.5	229.9	60.6	0.18	0.85	0.05	0.52
7.	PE/10% LSCa	9.4	748.1	256.1	77.4	0.95	0.75	0.15	1.17
8.	PE/10% LSAE	10.6	606.2	180.6	78.9	0.14	0.37	0.09	0.55
9.	PE/10% LSCaE	13.2	844.7	178.8	31.4	0.16	0.45	0.14	5.15
Natural (field) conditions									
13.	Reference plant	6.6	233.7	552.9	119.3	0.73	0.96	0.30	0.42
14.	PE	10.5	395.3	2424.4	430.8	11.43	2.96	0.64	2.49
15.	PE/Cellulose	6.9	260.6	376.5	107.6	0.72	1.42	0.64	1.22
16.	PE/EVA/ 20% LSA	4.7	216.3	1275.8	64.9	3.02	1.83	0.25	1.50
17.	PE/EVA/ S/ 20% LSA	9.1	343.5	1667.4	270.8	0.53	2.32	0.54	2.53