University of Applied Sciences
Research Institute of Horticulture
Institute of Horticulture

Test Report

Determination of resistance to root damage to flexible sheets and coatings for roof planting according to FLL-method (2002)

Product name:

Bituline EP 400 Antiracine

Principal/Manufacturer:

Onduline Avraysa A.S,
Plaza Spring Giz K.19/20 Büyükdere cad Meydan Sok. Maslak
34398 Istanbul
Turkey

The report compiles 34 pages and is only allowed to be used unabridged.
The report has a 10 years period of validity.
Date: 2006-02-14

Information given by Onduline Avraysa A.S concerning data and characteristics of the flexible sheet Bituline EP 400 Antiracine (2004-02-08)

- **Name of the product:** Bituline EP 400 Antiracine
- **Scope:** root preventing waterproofing membrane
- **Material designation:** polymer modified bitumen
- **Thickness (excluding bond):** 4 mm
- **Equipment/structure:** polyester felt reinforced polymer modified bitumen sheet
- **Delivery form:** rolls, width: 1 m, length: 10 m
- **Manufacturing technique:** modified bitumen impregnation of polyester felt
- **Product standards:** TS 11758-1
- **Test certificates:** TS 11758-1 test certificates
- **Year of manufacture:** 2003
- **Layer resisting to perforation:** polymer modified bitumen
- **Installation method at the test site:**
  - **overlap:** circa 100 mm
  - **jointing technique:** fusion welding by torch flame
  - **jointing agent:** none
  - **type of joint seal:** none
- **wall corner joint reinforcing:** none
- **cover strip over joints:** none
- **Addition of biocides incl. concentration:** 0.5 % of antiroot agent based on bitumen

1 Problem task

In order to prevent damage protection sheets against root perforation are required to perform permanent resistance against penetration or perforation by plant roots and plant rhizomes (subterranean offshoots).

In this test the resistance to root and rhizome damage of the sheet Bituline EP 400 Antiracine manufactured by Onduline Avraysa A.S, 34398 Istanbul, Turkey, was determined.

2 Test facility and procedure

The 2 years lasting test was carried out in accordance with the „Method of testing resistance to root damage to flexible sheets and coatings of roof planting“ (FLL, 2002). The complete description of the test procedure can be found in annex 3 of this report.

The test was carried out between February 2004 and February 2006 comprising 8 containers equipped with the sheet to be tested. Another 3 containers without sheet were serving as control that allows to compare the plant development in the different containers.

The sheet was cut, jointed and installed in the containers at the test site of the Institute of Horticulture, University of Applied Science Weihenstephan by an experienced roofer (Mr. Stephan Himmel, master roofer, 85356 Freising, Germany).

A check sample of the sheet was taken and stored at the testing institute.

The containers were installed in a climate-controlled glass house.

The test plant Pyracantha coccinea ‘Orange Charmer’, is a Firethorn variety with satisfying growth at the defined climatic conditions also during winter half year. The other test plant, Agropyron repens (Coach Grass), is forming rhizomes which can damage protection sheets as well as roots.

3 Data given by the manufacturer of the sheet

The test of resistance against root perforation refers to the data and material characteristics of the tested sheet and to the applied jointing and manufacturing technique. The data given by Onduline Avraysa A.S concerning the sheet Bituline EP 400 Antiracine are listed on page 2 of this report.

4 Results

4.1 Plant development

The plants, Firethorn and Coach Grass, performed well during the whole test period. Growth of the test plants in the control containers (without sheet) was only slightly differing from plant growth in the test containers covered by the sheet Bituline EP 400 Antiracine. The required minimum vigorousness of Firethorn in the test containers (80 % of the average vigorousness of growth in the control containers) was clearly exceeded (95 to 127 %).

Coach Grass performed from the first interim evaluation (August 2004) during the whole test period a high to very high density of stand. At the periodic evaluations in the 8 test containers on average 66 to 81 % of the substrate surface was covered with Coach Grass (nominal value ≥ 40 %).

Detailed information concerning vigorousness of growth are given in annex 2.

4.2 Penetration and perforation of roots an rhizomes

4.2.1 During testing period

The tested sheet did not show any sign of root perforation during the testing period when checked through the transparent bottom. Also no rhizomes penetrating or perforating the sheet were detectable.

4.2.2 At the end of test period (February 2006, 2 years after beginning)

At the end of the test period the containers were emptied for a detailed check of the sheet Bituline EP 400 Antiracine for root or rhizome penetration and perforation.

The sheet (surface and joints) did not show any penetrations or perforations caused by roots after the 2 year period (see table an photos in annex 1).

Some rhizomes had grown into the upper layer of the sheet without damaging the internal polyester felt. The penetrating rhizomes did in same cases grow several centimetres under the upper bitumen layer of the sheet along the polyester felt. Thereafter the rhizomes usually penetrated the upper bitumen layer again in the direction of the growing substrate.

A few rhizomes did penetrate the seems up to a depth of 18 millimetres.

Penetrations caused by rhizomes are not evaluated with regard to root resistance.

Table: Number of penetrations and perforations caused by roots or rhizomes concerning the sheet Bituline EP 400 Antiracine after the testing period of two years

Cont. No.	perforations caused by roots (ro) and rhizomes (rh)		penetrations caused by roots (ro) and rhizomes (rh)	
	surface	joints	surface*	joints**
1	none	none	48 (R)	2 (R)
2	none	none	27 (R)	none
3	none	none	46 (R)	2 (R)
4	none	none	41 (R)	3 (R)
5	none	none	53 (R)	2 (R)
6	none	none	26 (R)	none
7	none	none	38 (R)	none
8	none	none	33 (R)	none

*maximum depth of penetration: 2 mm **maximum depth of penetration: 18 mm

5 Summary

In accordance with the „Method of testing resistance to root damage to flexible sheets and coatings of roof planting“ (FLL, 2002) a two years lasting test was carried out with the sheet Bituline EP 400 Antiracine manufactured by Onduline Avraysa A.S, 34398 Istanbul,Turkey,.

The sheet Bituline EP 400 Antiracine (surface and joints) did not show any penetrations or perforations caused by roots after the 2 year period.

Some rhizomes had grown into the upper layer of the sheet without damaging the internal polyester felt. A few rhizomes did penetrate the seems up to a depth of 18 millimetres.

Penetrations caused by rhizomes are not evaluated with regard to root resistance.

The sheet Bituline EP 400 Antiracine is therefore considered to be root resistant according to FLL-standard.

The test on root resistance relates to the data and material characteristics as well as the applied jointing technique and manufacturing technique described on page 2 of this report.

Check samples of the tested sheet were taken and are stored at the Institute of Horticulture, University of Applied Science Weihenstephan.

The test report was compiled in February 2006. The report has a 10 years period of validity

This report comprises 34 pages and is only allowed to be used unabridged.

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Annex 1

Photos concerning the tested sheet Bituline EP 400 Antiracine (February 2006)

Figure 1: Test containers

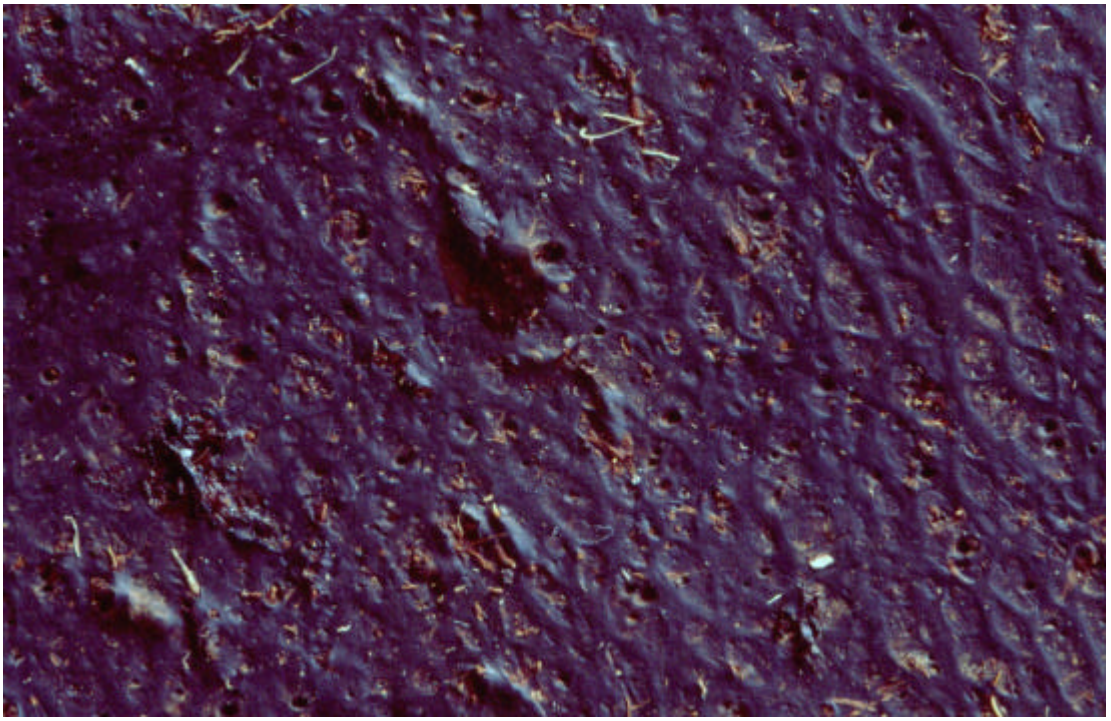

Figure 2: Sheet surface with adhesive roots

Figure 3: Cut through joint

Figure 4: Sheet surface with penetrated rhizomes

Figure 5: Cut through joint with a penetrated rhizome

Annex 2
Data on plant development

Table 1: Height and trunk diameter of Firethorn in 3 control containers

Cont. No.	Plant No.	August 2004		February 2005		August 2005		February 2006	
		Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm
1	**1**	1,2	200	1,5	235	1,9	255	2,4	330
	2	0,9	175	1,1	210	1,5	265	1,9	335
	3	1,2	200	1,4	230	1,8	235	2,2	300
	4	1,2	175	1,4	205	1,8	210	2,4	320
2	**1**	1,2	200	1,4	200	1,6	210	2,0	340
	2	1,1	195	1,3	220	1,8	245	2,1	335
	3	1,1	185	1,4	195	1,7	210	2,0	290
	4	1,2	210	1,4	205	2,0	250	2,3	310
3	**1**	1,1	190	1,4	210	1,9	270	2,3	360
	2	1,2	200	1,3	200	1,8	196	2,2	300
	3	1,1	210	1,6	250	2,1	310	2,5	375
	4	1,1	190	1,2	230	1,7	230	2,1	305

[1)] Trunk diameter measured at 20 cm above substrate surface

Table 2: Average height and trunk diameter of Firethorn in 3 control containers

Cont. No.	Plant No.	August 2004		February 2005		August 2005		February 2006	
		Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm
1- 3	**1-4**	1.1	194	1.4	216	1.8	241	2.2	325

[1)] Trunk diameter measured at 20 cm above substrate surface

Table 3: Height and trunk diameter of Firethorn in 8 test containers

Cont. No.	Plant No.	August 2004		February 2005		August 2005		February 2006	
		Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm
1	**1**	1,3	240	1,5	255	1,7	300	1,9	310
	2	1,4	245	1,6	300	1,8	305	2,2	340
	3	1,4	220	1,6	225	1,9	185	2,2	350
	4	1,2	180	1,5	235	1,8	215	2,1	275
2	**1**	1,4	225	1,6	285	2,1	330	2,5	395
	2	1,4	230	1,6	255	1,8	300	2,3	315
	3	1,3	210	1,5	240	1,7	265	2,1	310
	4	1,4	210	1,6	265	1,8	280	2,1	330
3	**1**	1,2	165	1,4	210	1,6	225	1,8	255
	2	1,3	185	1,5	240	1,7	265	2,1	310
	3	1,4	230	1,6	255	1,8	300	2,3	315
	4	1,4	195	1,5	210	1,8	290	2,3	265
4	**1**	1,4	175	1,7	180	2,0	215	2,3	215
	2	1,2	260	1,4	240	1,7	250	1,8	285
	3	1,4	230	1,6	255	1,8	300	2,3	315
	4	1,3	195	1,5	240	1,7	265	2,1	310
5	**1**	1,3	210	1,7	210	1,8	240	2,0	275
	2	1,5	240	1,7	300	2,0	275	2,4	365
	3	1,3	170	1,6	200	1,8	215	2,1	280
	4	1,2	150	5,0	220	1,8	210	2,2	280
6	**1**	1,3	200	1,6	245	1,7	245	1,9	290
	2	1,4	240	1,6	215	1,8	240	2,3	350
	3	1,4	220	1,6	210	1,9	235	2,3	365
	4	1,3	195	1,7	240	1,9	265	2,2	335
7	**1**	1,3	210	1,5	225	1,7	240	2,1	305
	2	1,4	225	1,6	230	1,9	265	2,3	315
	3	1,3	195	1,6	255	1,8	180	2,0	300
	4	1,3	220	1,5	215	1,9	210	2,2	285
8	**1**	1,5	235	1,7	250	2,0	290	2,3	300
	2	1,3	170	1,6	195	1,8	215	2,1	275
	3	1,4	230	1,7	290	2,0	315	2,4	385
	4	1,5	250	1,7	280	2,0	300	2,3	315

[1)] Trunk diameter measured at 20 cm above substrate surface

Table 4: Average height and trunk diameter of Firethorn in 8 test containers

Cont. No.	Plant No.	August 2004		February 2005		August 2005		February 2006	
		Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm
1-8	**1-4**	1.4	211	1.7	240	1.8	257	2.2	310

[1)] Trunk diameter measured at 20 cm above substrate surface

Table 5: Average values of height and trunk diameter of Firethorn in 8 test containers related to the values of the plants in 3 control containers (data in %, nominal value: [3] 80 %)

Cont. No.	Plant No.	August 2004		February 2005		August 2005		February 2006	
		Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm	Æ cm[1)]	Height cm
1-8	**1-4**	127	109	121	111	100	107	100	95

[1)] Trunk diameter measured at 20 cm above substrate surface

Table 6: Classification of the stand density of Coach Grass 3 control containers

Cont. No.	August 2004	February 2005	August 2005	February 2006
	stand density (in %)	stand density (in %)	stand density (in %)	stand density (in %)
1	75	80	85	90
2	70	80	80	85
3	75	75	80	80

Table 7: Average values of the stand density of Coach Grass 3 control containers

Cont. No.	August 2004	February 2005	August 2005	February 2006
	stand density (in %)	stand density (in %)	stand density (in %)	stand density (in %)
1-3	73	78	82	85

Table 8: Classification of the stand density of Coach Grass 3 test containers

Cont. No.	August 2004	February 2005	August 2005	February 2006
	stand density (in %)	stand density (in %)	stand density (in %)	stand density (in %)
1	65	70	75	75
2	75	75	80	90
3	60	65	70	80
4	60	75	75	80
5	75	75	75	75
6	65	70	80	85
7	65	70	70	80
8	60	70	80	85

Table 9: Average values of the stand density of Coach Grass 8 test containers (nominal value: ^{3} 40 %)

Cont. No.	August 2004	February 2005	August 2005	February 2006
	stand density (in %)	stand density (in %)	stand density (in %)	stand density (in %)
1-8	66	71	76	81