Università degli Studi di Napoli Federico II
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Il Commissario di Governo
per l'Emergenza Rifiuti in Campania - Italia

Sogin
Società gestione impianti nucleari

PHYTOTOXIC DAMAGE AND REMEDIAL ACTIONS AT AN OLD LANDFILL SITE IN SOUTHERN ITALY

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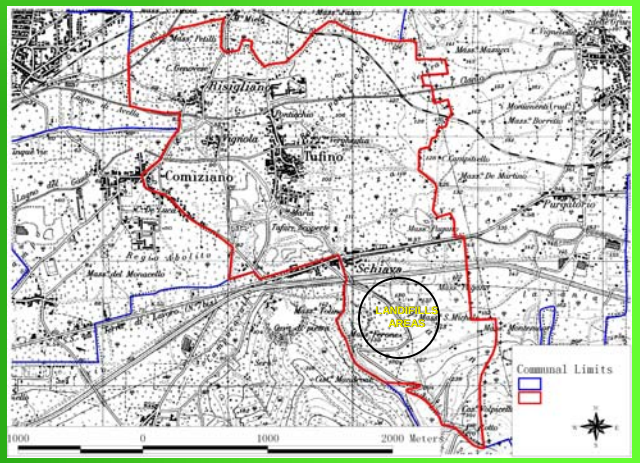
NATO / CCMS Pilot Study – Prevention and Remediation in Selected Industrial Sectors: Rehabilitations of Old Landfills
CARDIFF, May 23 – 26, 2004

LANDFILL SITE

Over 2,000,000 m^3 of municipal solid wastes have been disposed in Paenzano landfills, sited in the city of Tufino near Naples, Campania, Southern Italy, in the periods 1996÷1999 (Paenzano 1 landfill) and 1999÷2001 (Paenzano 2 landfill).



TUFINO (NA)

LANDFILL SITE AND INVESTIGATION AREA

LANDFILL SITE AND INVESTIGATION AREA

Paenzano 1 Landfill

Paenzano 2 Landfill

PHYTOPATHOLOGICAL INVESTIGATION

PURPOSES

Definition of the phytosanitary conditions of the cultivated land around the two landfills Paenzano 1 and Paenzano 2.

Study of the phenomena of declining and death of vegetation.

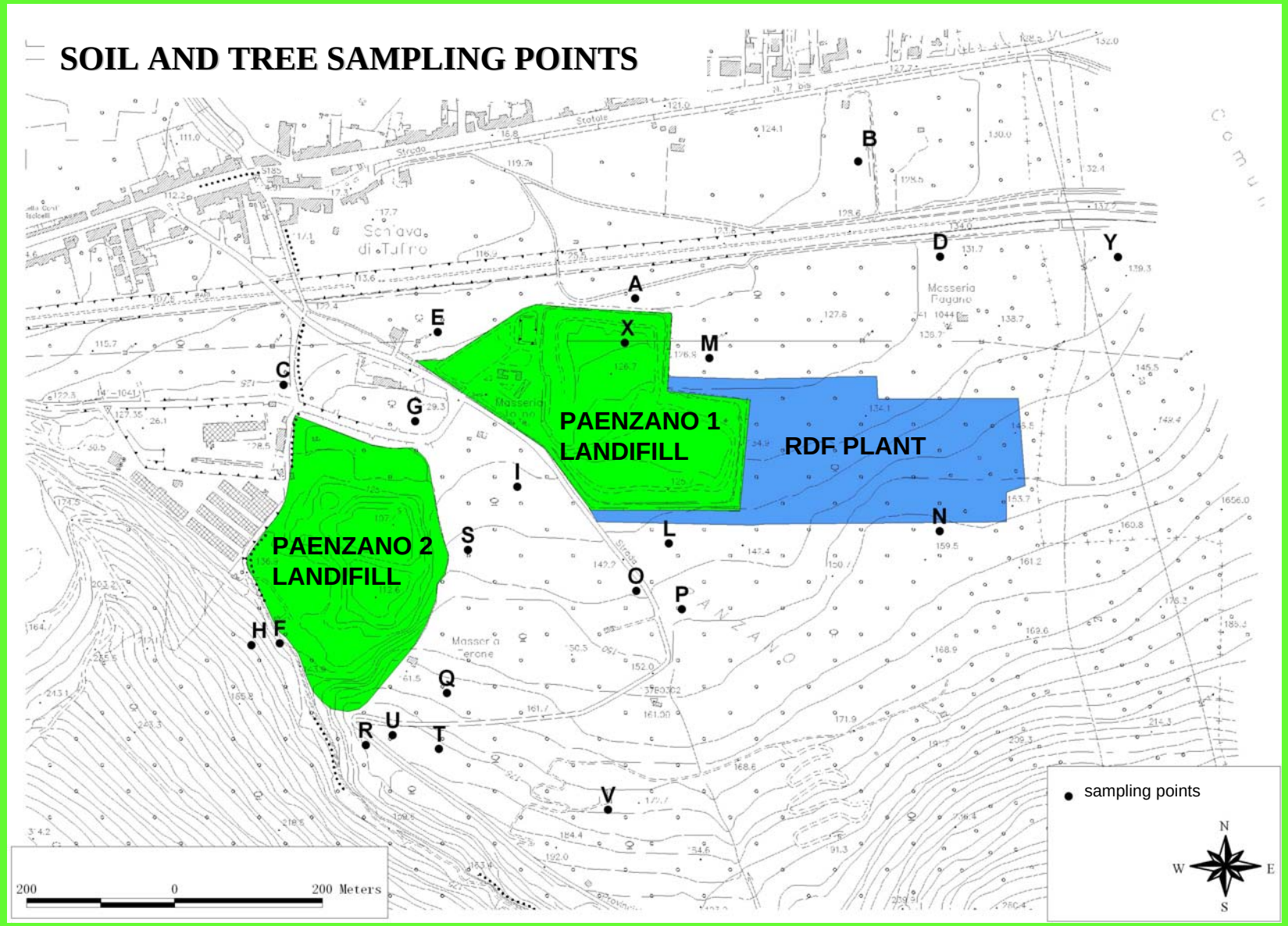
Determination of the possible negative effects on the surrounding area vegetation caused by the two landfills.

PHYTOPATHOLOGICAL INVESTIGATION

METHODS

- Location of the monitoring area (01/2002 – 12/2002), where plant samples were taken.
- Interviews with farm owners where tree decline was evident in order to reconstruct the anamnesis.
- Periodical inspection on the vegetative status of trees and weeds.
- Selection of declining plant samples to be analysed according to species, age and physiological condition.
- Distribution of declining – trees, and apparently healthy ones, in relation with the distance from landfills.
- Sampling of plant tissues and/or epigeous/ hypogeous organs according to the evidence of symptoms during the investigation period.
- Collection and transportation of soil samples from the area of declining trees to a screen house in order to verify phytotoxic effects under controlled environment conditions.

PHYTOPATHOLOGICAL INVESTIGATION



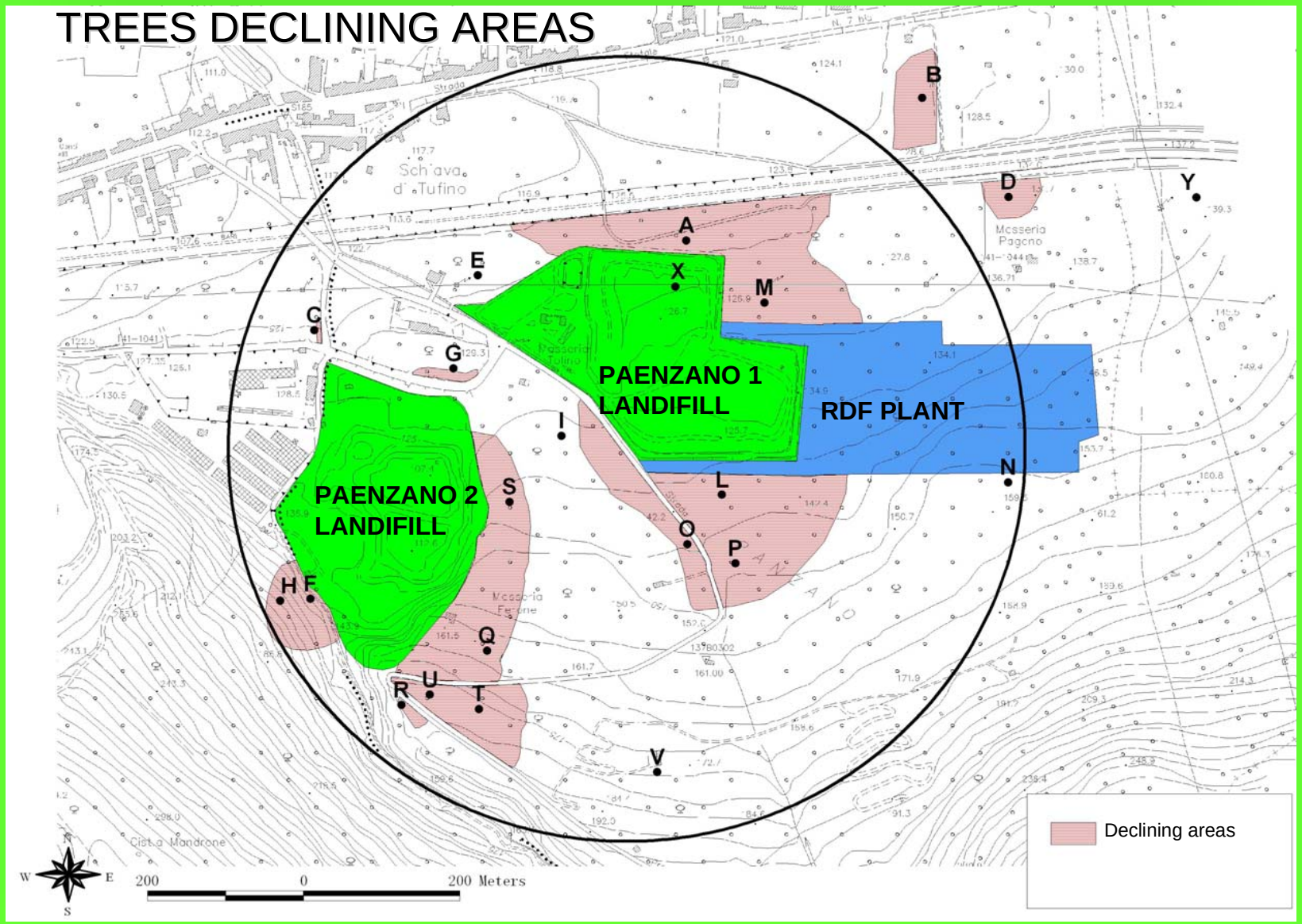
PHYTOPATHOLOGICAL INVESTIGATION

LAB INVESTIGATION

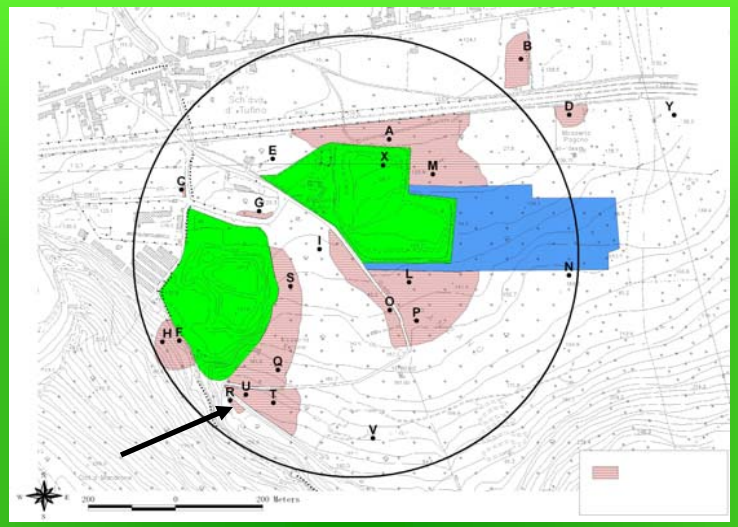
- Visual and dissecting examination of tree samples.
- Preparation of moist chamber and isolation of fungi and bacteria.
- Purification and transfer of the inocula in order to identify the isolated organisms.
- Test of pathogenicity.
- Histopathology of herbaceous and woody tissues.
- Assessment of the final result in comparison with the data obtained from other institutes involved in the research of the physico - chemical structure of the soil and related watery and gaseous components.
- Drawing up of an intermediate and final report.

PHYTOPATHOLOGICAL INVESTIGATION

TREES DECLINING AREAS



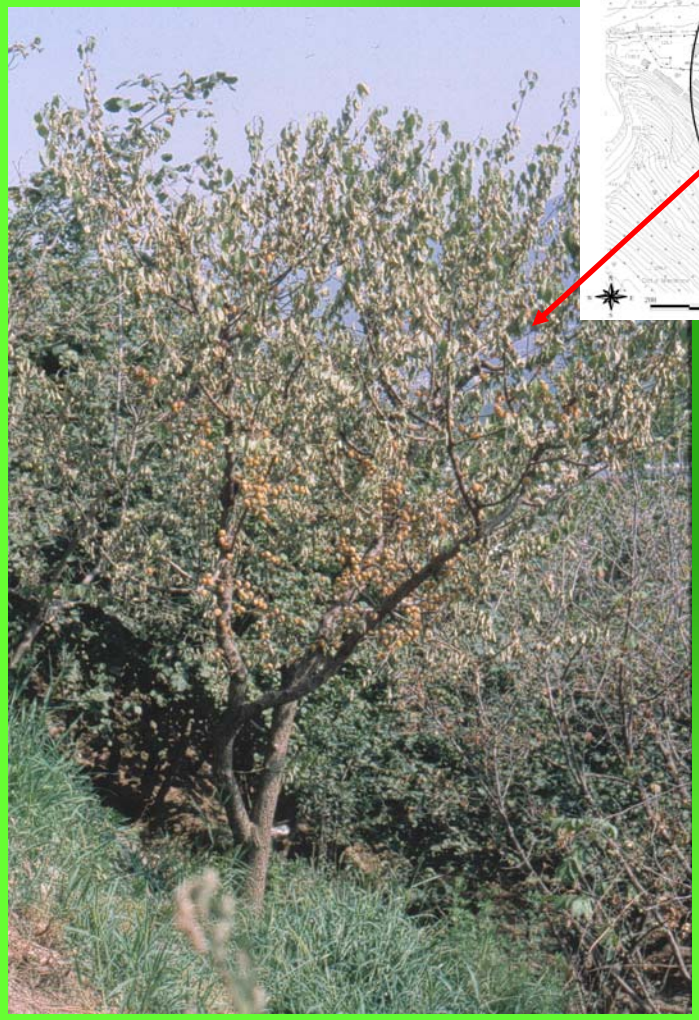
PHYTOPATHOLOGICAL INVESTIGATION

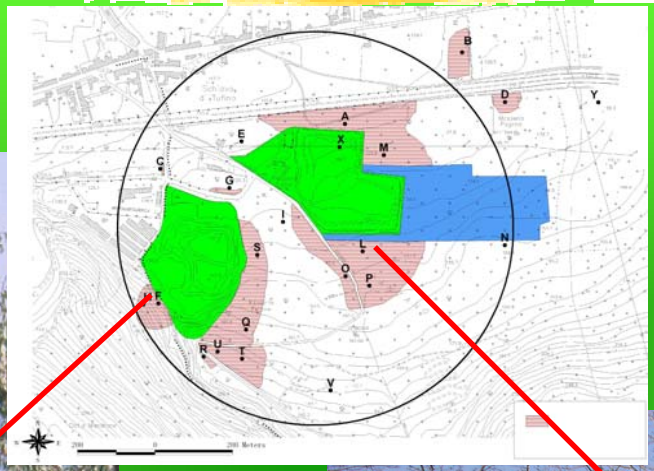


U area – It is clear that weeds with tap-root (amaranthus sp) were severely damaged.

Detail of the U area

PHYTOPATHOLOGICAL INVESTIGATION





Different aspects of declining Hazel and Apricot trees

PHYTOPATHOLOGICAL INVESTIGATION

SOIL SURVEY

Following the tree-tissues sampling, a survey of the soil has been carried out in order to identify possible causes able to threat vegetation health.

Samples of the interstitial gas have been taken to verify its temperature besides CO_2, CH_4, O_2 and N_2 contents.

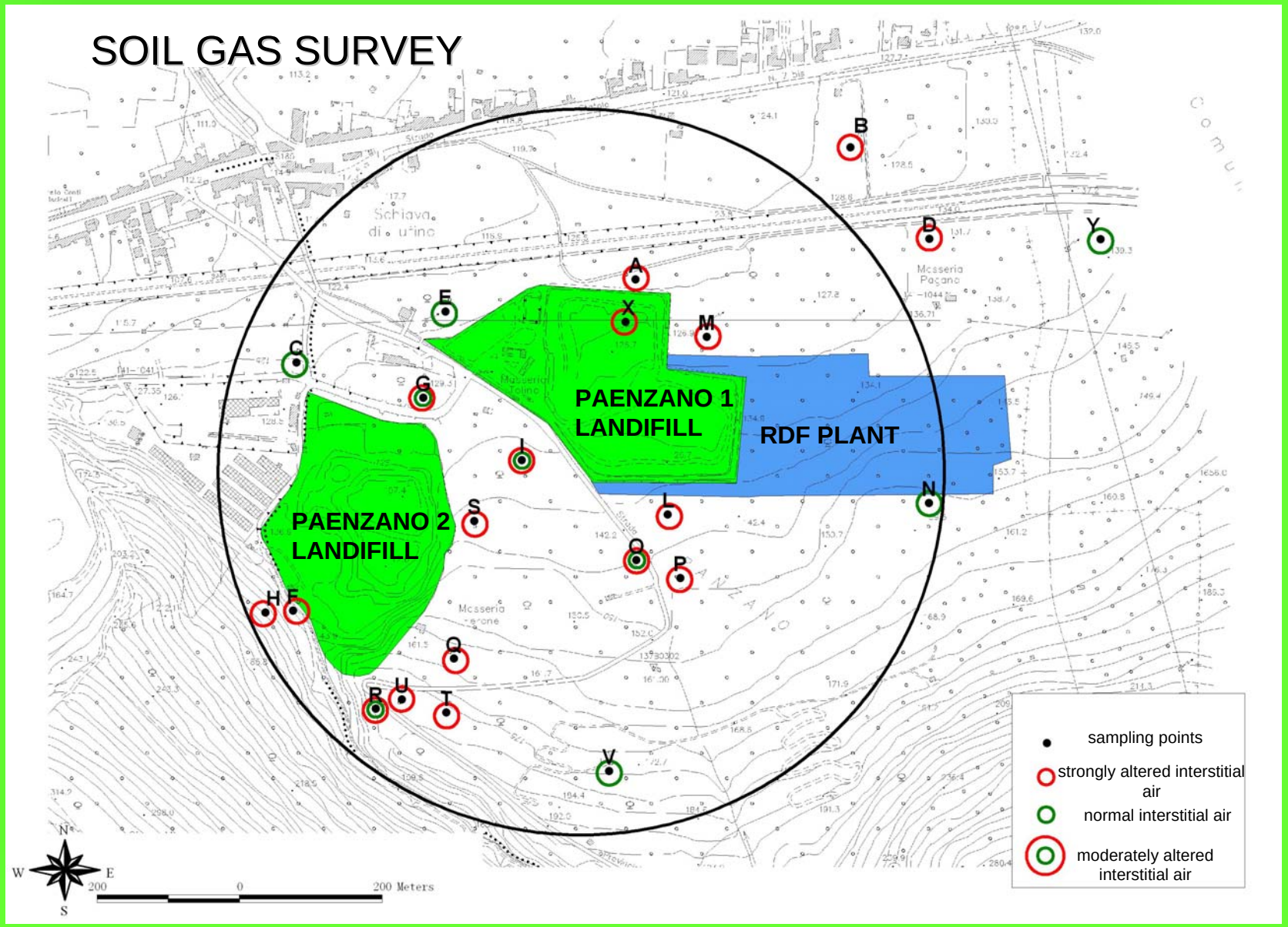
The aim was to investigate the possible correspondence of damaged vegetation with areas having anomalous temperature and gas content, and their relationship with biogas released into the environment by the nearby landfills.

PHYTOPATHOLOGICAL INVESTIGATION

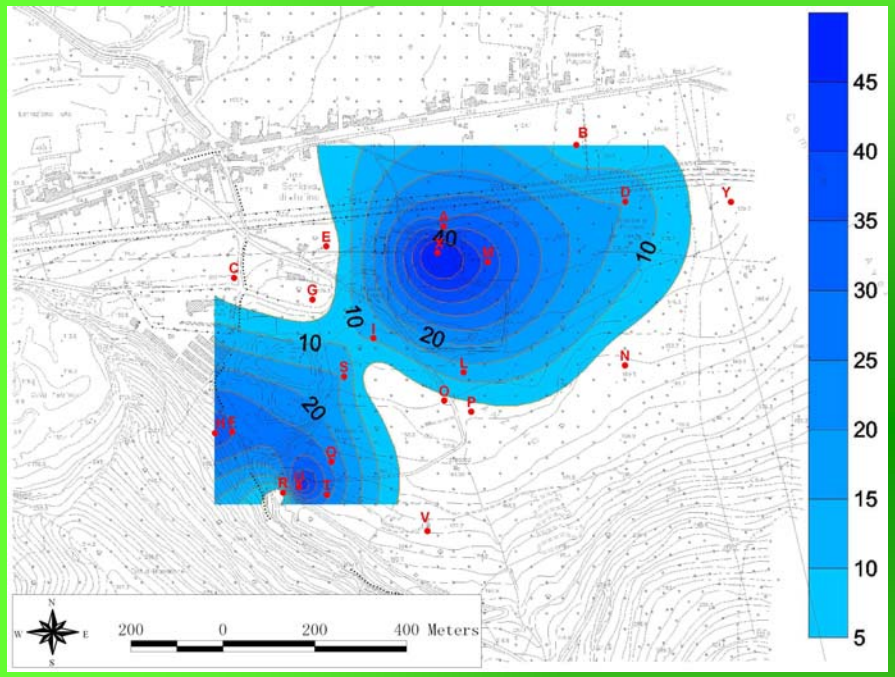
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	TUFINO-T`-GAS-Campioni Veg.xls																		
2					Temperature del terreno rilevate alle profondità di 20, 40 e 80 cm nei mesi di Maggio e Ottobre 2002														
3						Maggio	Ottobre		Maggio	Ottobre		Maggio	Ottobre		Analisi dei gas interstiziali. 5-2002				
4	Zona	Campioni vegetali	Gas			20	20		40	40		80	80		%	O2	N2	CH4	CO2
5	A	22,23,24,25,40,41	biogas		A	23,2	18,1		23,1	18,5		21,8	20		A	1,0	36,4	31,7	30,9
6															A	0,8	35,2	31,9	32,1
7	B	44,45,46,47	biogas		B	19,6	21,5		22,6	22,1		22,5	23,1		B	0,8	79,3	5,4	14,4
8	C	34,35	aria	*	C	18,2	17,1		17,8	18,8		17,2	21,6		C	20,7	78,7	0,0	0,5
9	D	26,42,43	biogas		D	27,2	20,6		26,1	21,2		25,2	22,6		D	0,6	69,8	15,0	15,9
10	E	36,39	aria	*	E	17	14,2		16,7	15,2		15,9	15,3		E	20,6	78,7	0,0	0,7
11	F	np	biogas		F	26,2	17,7		29	19,1		28,1	22,9		F	0,7	42,6	30,5	26,3
12	G	27,28,36,37	a - b		G	19	14,6		20,2	15,1		20,2	nd		G	15,2	80,3	0,0	4,5
13	H	20,21,29,30,31,32,33	biogas		H	43,1	22,3		42	26,2		39,1	28,7		H	1,1	38,1	34,2	28,8
14															H	0,9	36,6	33,2	29,3
15	I	1,2,3,4	a - b		I	21,8	18		22,2	20		22,3	22,1		I	13,4	78,6	0,0	6,4
16	L	5,6,48,49	biogas		L	25,3	21,8		28,1	23,3		26	24		L	2,9	61,5	12,5	23,0
17															L	1,5	60,4	13,6	24,4
18	M	np	biogas		M	29	20,1		27,8	21,7		26	21,6		M	3,6	28,7	38,6	29,0
19	N	7,8,9	aria	*	N	17,8	12,6		16,6	13,8		16,2	14,8		N	20,9	78,7	0,0	0,4
20	O	51,52	a - b		O	24	24,4		23,5	26,4		23,5	26,2		O	14,7	80,0	0,0	5,4
21	P	50	a - b		P	24	24,3		23,5	25,1		26,90	25,3		P	7,4	76,3	2,7	13,7
22	Q	np	biogas		Q	28,7	21,2		28,3	23,1		25,9	23,1		Q	0,5	47,5	23,8	28,2
23															Q	0,5	48,0	23,7	27,8
24	R	15,16,17,18,19	a - b		R	21,8	20,1		21,9	20,7		23,2	21,3		R	10,6	80,3	0,0	9,1
25	S	53	biogas		S	26,5	20,2		28,3	21,5		27	24		S	0,9	59,0	15,0	25,1
26			??		S1		15			16,5			16,7		S	0,6	58,3	15,1	26,0
27	T	55,56	biogas		T	28	19,8		27,6	21,1		25,6	20,7		T	3,0	45,7	26,3	25,0
28	U	10,11,12,13,14	biogas		U	29,9	23,7		29,8	24,6		28,2	24,8		U	0,7	16,8	46,9	35,6
29															U	0,8	17,0	46,1	36,1
30	V	58	aria	*	V	16,2	13,2		15,8	13,9		14,4	16,2		V	20,8	78,8	0,0	0,5
31	X		biogas		X	25,2			27			25,2			X	1,4	5,2	56,6	36,8
32															X	1,1	4,8	56,5	37,7
33	Y		aria	*	Y	16			15,1			14			Y	20,4	78,6	0,0	1,0
34															Y	20,4	78,8	0,0	0,8
35																			

Soil temperature and soil-gas composition

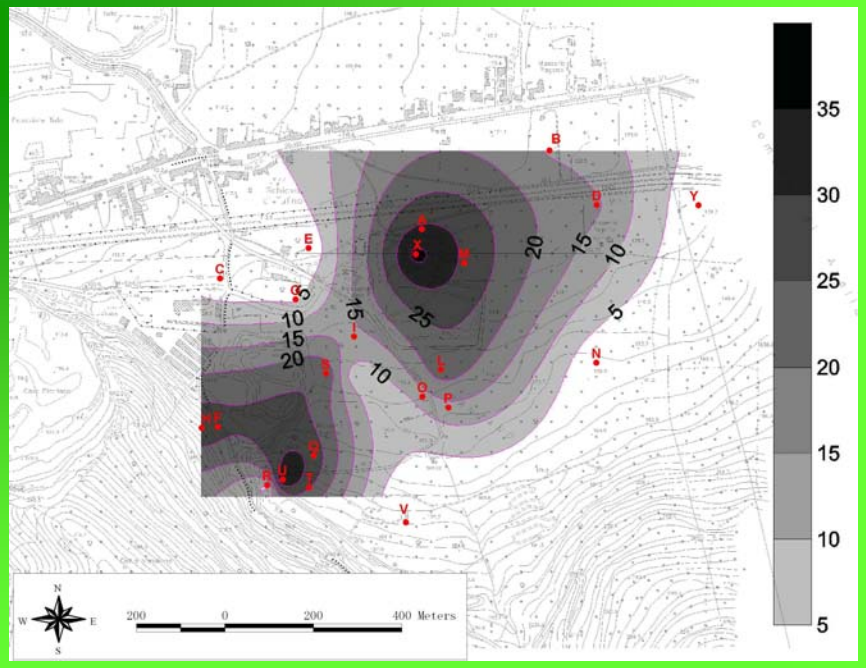
PHYTOPATHOLOGICAL INVESTIGATION



PHYTOPATHOLOGICAL INVESTIGATION



CH_4 Isoconcentration



CO_2 Isoconcentration

PHYTOPATHOLOGICAL INVESTIGATION

Roots severely damaged (“steamed”) by vapour showing blue – grey tissues

PHYTOPATHOLOGICAL INVESTIGATION

Cross section of a hazel root. The phloem is brown and dead

The cambium is completely dead and areas of collapsed cells are visible

PHYTOPATHOLOGICAL INVESTIGATION

CONCLUSIONS

•The field observations and all laboratory investigations definitely exclude the presence of primary biotic agents as a cause of plant declining in the landfills area.

•The histopathologic analyses of root samples clearly showed that tissue cells had died because of their exposure to incompatible temperature.

•It can be supposed that high temperatures and lack of oxygen could have impacted on the plants at the same time, or even with synergic effects.

•The analyses of interstitial gas composition and the temperature measurements at different depths in different farming areas, showed anoxic conditions and anomalous heat in all soils where recent or old plant declining was evident.

PHYTOPATHOLOGICAL INVESTIGATION

CONCLUSIONS

• In the analysed soils, no potentially phytotoxic substances, either in the solid components or in the liquid ones, were found.

• The results of growth tests on five different vegetal species, carried out at the Plant Pathology Department in soil samples taken from the declining area, clearly showed that the agent of plant declining was not in a steady form.

• Blending and airing those soils was sufficient to remove the cause of declining, that is, a fleeting agent (heat) and/or a volatile agent (biogas).

LANDFILL GAS MITIGATION

A mitigation plan based on two typologies of gas extraction well networks has then been laid out:

- improvement of a well system for the extraction of landfill gas inside the landfills connected to a plant for recovery and production of electric energy,
- drilling of perimetral wells beyond landfill boundaries having a barrier function to landfill gas diffusion outside landfill bodies.

LANDFILL GAS MITIGATION

Paenzano 1 - August 2002

Paenzano 1 - April 2004

LANDFILL GAS MITIGATION

Paenzano 2 - August 2002

Paenzano 2 - April 2004