Terroir Hesse – Soil determines wine style

Terroir Hesse - Le sol détermine le style du vin

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Abstract

The project "Terroir Hesse" works out the main type and characteristics of soil-based terroirs and the resulting wine styles for the hessian wine-growing regions Rheingau and Hessian Bergstrasse. The soils of the examples presented were developed of weathered material of quartzite, loess, windborne sand, clay and fluvial sediments. On the sites, wines were produced from Riesling grapes. Vinification was conducted in a conservative and reserved manner. Typical differences in main wine sensory characteristics could be attributed to soil characteristics such as particle size, geology, nutrient status and lime content ($CaCO_3$). Wine composition such as body, sensorial acidity and aroma potential can partly be explained by water storage and nutrition status. Soil texture has a major influence on vine development and consequently on the characteristics of the wine. In fact, soil characteristics can help to explain differences in wine style within the same region or climatic classification. The results show that the main soil characteristics explain wines of significantly different composition, appearance and flavour.

Keywords: Terroir, Soil, Wine Style

Introduction

Germany is located at the northern border of world viticulture. Only vineyard sites of superior sun exposure, wind and frost protection are utilized for viticulture. Thus, quality classification of german wines focuses on grape maturity, which is determined by sugar concentration in the grape juice and final sensory evaluation of the wine. This classification was not able to differentiate wine styles with differences in flavor or sensorial structure of the wine. Today, the discussion of the concept of terroir evokes an increased awareness for different regional wine styles. A terroir is a group of vineyards from the same region, sharing the same type of soil and climatic conditions, which give its specific personality to the wine. Even though there is no doubt concerning the major role of climate for grape maturity for our region, the link between viticultural, climatic and soil parameters and their over-all effect on wine style composition is still unclear. Soil texture may have a major influence on vine development and consequently on the characteristics and the regional differentiation of the wine (Sittler 1995). Anyhow, only a few published papers are able to explain the effect of the soil (f.e. Fischer et al. 1999, des Gachons et al. 2005, Koundouras et al. 2006, de Andres-de Prado et al. 2007). In Germany, Wahl moved seven different soil types to the same vineyard site in lysometers to study the impact of soil type on wine composition and sensory quality of Sylvaner wines. Thus, there was no effect of climatic interaction. He and others reported no significant impact on wine flavor of the investigated soil types (Wahl & Patzwahl 1997, SCHENK ZU TAUTENBURG 1999). In contrast, due to the experience of the staff of the Institute for Soil Science and Plant Nutrition, Geisenheim Research Centre for Viticulture (FAG), wine style often shows interrelations with the substratum of the soil, even when other conditions such as meso- or microclimate or vinifivation are not homogenious. Hence, the project "Terroir Hesse" aims to work out and describe the main type and characteristics of soil-based terroirs and the resulting wine styles for the hessian wine-growing regions Rheingau and Hessian Bergstrasse.

Material and methods

Selection of Experimental Area.

Riesling is the main grape variety of the Rheingau and the Hessian Bergstrasse**.** The vineyards of the Rhine Valley are situated along the 50° of latitude and mostly orientated to the Southwest (Rheingau) and the West (Bergstrasse). Data of hessian vineyard soils provided by Hessian Environmental and Geologic Service were used to select more than 20 sites, which represent the characteristic soils of the Regions. The vineyards are located between Lorch in the north and Heppenheim in the south. The soils were developed of weathered material of slate, phyllite, quartzite, sandstone, chalk, granite, loess, windborne sand, clay or marl, gravel and fluvial sediments (quarternary alluvium). No information was obtained concerning Rootstock and Clone in the vineyards. Planting density and age of the vineyards varied few (15 to 25 years).

Soil Analyses.

Soils were described in the field according to the field manual of the German Geologic Service. Soil samples were analysed in the laboratory of the Institute for Soil Science and Plant Nutrition, using standard methods.

Winemaking.

On the sites, wines were produced from Riesling grapes. In order to fully transfer characteristics of the grapes to the wine, vinification was conducted in a conservative and reserved manner. Grapes were harvested manually at similar maturity within one week. Grapes were immedeately pressed after harvesting. Due to climatic conditions in autumn 2006, grapes partly were infected by botrytis fungal. In order to avoid negative effects of botrytis, must of 6 sites was pasteurised. Fermentation took place in cooled stainless steel vessels with standardized application of a neutral dried yeast (Oenoferm Stamm Klosterneunburg, Erbslöh) and addition of bentonite.

Wine Analysis and sensory description.

Wine parameters were analyzed with an FT-IR spectrometer by the FAG, Section Section Wine Analysis and Beverage Technology**.** An evaluation of sensory properties was used to determine whether typical differences in wine characteristics exist between the wines. Jugdes where chosen from the staff of the FAG to evaluate sensory properties of the wines.

The 6 plots vary significantly in stoniness and texture and therefore in soil water capacity. The quartzitic soils of Lorch and Rüdesheim contain considerably amounts of gravel and stones (table 1). The fine material consists of weathered quartzite and loamy, clayey loessian material. Primary because of the stoniness, available water capacity is low (67 mm and 64 mm respectively for a soil depth of 100 cm), resulting in a dry water regime for both sites. Warm soil-climate enhances vegetative growth in spring. During the ripening period in late summer, water supply on this sites is restricted. The silty loess soils of Winkel and Heppenheim provide sufficient water resources throughout the entire growing and ripening period (water capacity is 190 mm and 200 mm respectively). The clay soil (Pelosol) of Hattenheim and the sandy alluvial soil of Hochheim have a medium water storage capacity (127 mm and 139 mm respectively). The clayey tertiary marine Sediment is waterlogged in spring and dry in late summer. Hence, on this site growing period starts considerably later and ripening period is restricted by water deficits. Due to fertilization, on each site the top soils contain adequate amounts of the main nutrients potassium, magnesium and phosphorus (table 2). The loessian soils and the subsoil of Hochheim (limestone-detritus) contain considerably amounts of lime ($CaCO_3$)

Site and geological origin		Organic Matter (%)	Texture of fine soil	Stoniness (Vol%)
Lorch (Quartzite)	Topsoil	1,2	sandy Loam	>60
	Subsoil	<0,5	sandy Loam	>60
Rüdesheim (Quartzite, Slate)	Topsoil	1,5	sandy Loam	40
	Subsoil	<0,5	clayey Loam	>60
Winkel (Loess)	Topsoil	5,3	silty Loam	1-2
	Subsoil	<0,5	clayey Silt	1-2
Heppenheim (Sandy Loess)	Topsoil	4,2	silty Loam	0
	Subsoil	<0,5	sandy Silt	0
Hattenheim (Tertiary Clay)	Topsoil	3,0	clayey Loam	1-2
	Subsoil	<0,5	sandy Clay	1-2
Hochheim (Quaternary alluvium)	Topsoil	2,3	loamy Sand	1-2
	Subsoil	<0,5	clayey sand	>80

Table 1 Soil Characteristics of the Studied Plots (a)

		pH	$CaCO_3$ (Vol%)	K_2O (mg/100g)	Mg (mg/100g)	P_2O_5 (mg/100g)
Lorch	Topsoil	7,2	0	17	14	24
	Subsoil	7,1	0	12	13	20
Rüdesheim	Topsoil	5,7	0	20	10	24
	Subsoil	4,4	0	7	30	3
Winkel	Topsoil	7,2	11,8	19	21	54
	Subsoil	7,8	16,0	2	10	4
Heppenheim	Topsoil	7,5	10,8	51	13	32
	Subsoil	7,9	12,6	11	7	6
Hattenheim	Topsoil	7,4	1,3	42	16	26
	Subsoil	7,7	0,8	7	13	3
Hochheim	Topsoil	7,6	2,7	29	12	54
	Subsoil	7,8	7,3	8	5	3

Table 2 Soil Characteritics of the Studied Plots (b)

Results and Discussion

The results show great differences in wine style for the six sites. Vine water status and seems to be the major attribute affecting maturity and therefore structure and flavour of the vines. Higher amounts of ash and residual sugar causes more body and directly affects the perception of the wine acidity. Hence, wines with light body (Lorch, Heppenheim) have lower pH-values, less buffered acids and wine style is dominated by the perception of the acids. Both wines from sites with medium water storage and suboptimal maturation conditions (Hattenheim, Hochheim) have a medium body. They appear light and fresh. In contrast, the grapes from rüdesheim unexpecetedly showed highest maturity, induced by severe dryness. Grape size and yield were lowest on this site. Hence, in autumn sugar production and decomposition of the acids in the grape were highest. Optimal water supply on the loess soil in Winkel lead to very good grape maturity, resulting in a body-rich, well structured wine of great harmony.
The sensorial profiles of the wines vary tremendously and show significant differences in flavour composition. Both quartzitic wines have a typical minerally flavour. This may be caused by the significant high content of manganese. The wines with the best maturity of grapes have intensive flavours of mature sweet fruits such as Mango/Passion Fruit, peach/apricot or sweet flavours (honey/caramel). In contrast, the wines of grapes with less maturity show predominantly fine flavours of fresh citrusfruits such as lemon or grapefruit. The characteristic attribute of the wine of Hattenheim-Clay are salty, spicy-aromatic flavours. A fine bitterness is found to be typical for wines from loessian soils.

Apart from calzium, no correlation could be found between nutrition content of the soil and content of the element in the wine. The wines from the calcarious soils show high amounts of calzium and low potassium concentrations. Those wines appear to have well-buffered acids.

		Lorch	Rüdes-heim	Winkel	Heppen-heim	Hatten-heim	Hoch-heim
grape maturity	°Oe	87	96	95	87	90	92
alcohol	g/L	95,4	106,9	105,8	92,8	95,7	98,2
ash	g/l	20,3	21,9	23,8	19	23,1	26,9
residual sugar	g/l	2,8	12,1	8,9	1,5	2,0	2,7
titratable acidity	g/l	6,8	6,0	7,0	6,1	6,2	7,8
tataric acid	g/l	3,1	2,5	3,4	2,8	2,1	3
malic acid	g/l	3,1	3,1	2,9	2,8	3,8	3,6
lactic acid	g/l	0,5	0,8	0,9	0,7	0,5	0,7
pH		2,8	2,9	2,8	2,9	3,0	2,8
nitrogen	mg/l	115,5	52,8	95,8	82,2	84,8	83,3
phosphorus	mg/l	74,2	131,7	58,9	95,9	95,0	146,1
potassium	mg/l	691,7	803,3	588,3	705,0	1066,7	903,3
calcium	mg/l	76,3	91,7	114,0	113,0	79,0	106,3
sodium	mg/l	16,0	13,3	18,3	20,0	18,0	20,0
magnesium	mg/l	72,0	93,3	102,0	76,7	91,7	91,7
iron	mg/l	1,17	1,17	1,37	1,17	1,23	1,37
manganese	mg/l	1,63	2,57	1,40	0,83	0,90	1,03

Table 3 Wine characteristics

	Lorch	Rüdes-heim	Winkel	Heppen-heim	Hatten-heim	Hochheim
	average	average	average	average	average	average
Lemon/Grapefruit	3,6	2,2	3,2	3,0	3,0	3,5
Peach/Apricot	2,4	3,0	2,7	2,0	2,2	2,2
Apple	2,9	2,2	2,8	2,8	2,8	2,9
Mango/Passion Fruit	1,6	2,8	2,9	1,6	2,0	1,9
Rock Melon	1,5	2,8	2,7	1,8	1,9	1,7
Honey/Caramel	1,2	2,4	2,2	1,5	1,7	1,3
Bloomy	1,9	2,6	2,9	2,4	2,4	2,1
Green Grass	3,1	1,5	2,9	2,4	2,4	2,1
Acidity	3,4	1,6	1,9	2,9	2,5	2,6
Mineral	3,7	3,2	2,2	2,7	2,5	2,4
Bitterness	2,0	1,6	1,6	2,7	3,4	3,0
Softness	2,1	3,0	3,2	2,1	2,5	2,2
Body	2,4	3,8	3,6	2,1	2,7	2,8

Table 4 Wine sensorial characteristics

Conclusion

Typical differences in main wine sensory characteristics could be attributed to soil characteristics such as water storage capacity, geology, nutrient status and lime content ($CaCO_3$). Wine composition such as body, sensorial acidity and aroma potential can partly be explained by water storage. Soil texture has a major influence on vine development and consequently on the characteristics of the wine. In fact, soil characteristics can help to explain differences in wine style within the same region or climatic classification. The results show, that the main soil characteristics explain wines of significantly different composition, appearance and flavour. Soil-based terroirs can be figured out by the soil type.

The soil-based characterisation of Hessian Wineyards will be used for an individualized marketing of Terroir-Wines.

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