Effect of different Horn pebbles and Horn orthoclase preparations

Experiment with potatoes and spring wheat

Dr. habil. Hartmut Spiess
Christoph Matthes,
Research & Breeding
Dottenfelderhof,
www.forschung-dottenfelderhof.de
h.spiess@dottenfelderhof.de

In the practice of biodynamic farming, it is common to use ordinary quartz or rock crystal for the horn silica preparation (Demeter eV 2013).
However, in the "Agricultural Course" Rudolf Steiner (1924) also mentioned orthoclase or feldspar for the production of this spray preparation. The recommendation states that "quartz or pebbles, or orthoclase, feldspar" should be ground into powder, mixed with water as a paste and filled into the cow horns.
According to this information, many experiments have been carried out in biodynamic research over the years and the effectiveness of this preparation has been demonstrated (König 1999, Spieß 2011).

A modification in the production of the "silica preparation" appeared shortly after the "Agricultural Course" in a letter dated July 10, 1924, which was found in the Goetheanum archive in 2000. which was probably written by Günther Wachsmuth on behalf of Rudolf Steiner to Count Keyserlingk. Steiner then recommended that one medium-sized crystal, ground into flour, should be kneaded with the field soil that will later be sprayed on, filled into the horns and sealed with pitch (Fig. 1 a–c).

To date, this information has hardly been used in biodynamic practice.

The differences between minerals

The fact that differences in effect are conceivable with regard to the substances used is derived from the mineralogy of the substances. The mineral type quartz is silicon dioxide with the sub-types rock crystal, chalcedony, agate and opal. The SiO4 tetrahedra are typical of the crystal structure of pure quartz . These wind in trigonal symmetry

Turning left-handed (right-hand quartz) or right-handed (left-handed quartz) around a screw axis, with twin quartz in both forms. In common quartz both forms occur almost equally distributed (Rykart 1995). Studies have shown that when used for the biodynamic silica preparation, right-hand quartz produced stronger growth effects in plants than left-hand quartz (Senger 1987).

According to Schad (2011), this is also to be expected, since the first product of every plant during photosynthesis is glucose, a right-handed sugar. With a Mohs hardness of 7, quartz is a hard mineral. It occurs in many modifications.

Orthoclase is assigned to the mineral class of silicate minerals. Within this, orthoclase is a representative of the feldspars. According to its chemical composition, it is called potassium aluminosilicate (KAl-

Figure 1: from left: kneading quartz powder into soil, filling the horn, closing it with pitch

Si3 O8). Adular and sanidine are considered varieties of orthoclase. The Mohs hardness is 6. The crystals are monoclinic and often form interpenetration twins. For a characterization of the substances, please refer to the text "On the essence of orthoclase" (Bosse 2009).

Another thought should be added regarding the soil to be used. In the agricultural course, Steiner speaks of the fact that the preparations, namely the stinging nettle preparation, have an individualizing effect through the fertilizers in that "the soil individualizes itself to the plants that you want to grow." It is conceivable that for this reason the soil for the preparation should be taken from the field on which the preparation is later to be used.

What is also important for the present study is that at exactly this point in the course (p. 133) Steiner (1924) points out the improvement of the fertilizer through the preparations with regard to the nutritional power that can be achieved in the agricultural products . As part of these investigations, parameters of nutritional quality should primarily be used. As far as this was possible, specific valuable ingredients were determined and methods for examining the quality of formative forces and vitality were included.

As far as is known, the first scientific studies on the effect of biodynamic silica preparations with comparative use of both substances are only available from the authors with experiments at the Dottenfelderhof, Bad Vilbel (Demeter since 1968). In container test series with bush beans

Effect of right and left quartz as well as commercial preparations, orthoclase powder from Odenwald was used experimentally for the first time. Differences in effect primarily affected qualitative parameters such as: B. seed vitality (driving power), with the orthoclase preparation achieving significantly higher values. However, in a summary of 15 test parameters, the orthoclase treatment tended to be inferior to the usual silica preparation (Spieß 2009).

Field tests with pebbles or Orthoclase preparations for potatoes 2010

In 2009, for a new field test, preparations with quartz/rock crystal and orthoclase from Odenwald origin were produced according to the instructions described at the beginning in the different processing mentioned with and without arable soil (see Fig. 2). The soil used came from a test field that was retained for the duration of the tests. The soil analysis of all sections resulted in a very homogeneous test field. The experimental setup was a randomized Latin square with five repetitions and the following preparation variants: 1) control (water spray), 2)

Horn pebbles, 3) Horn pebbles earth, 4) Horn orthoclase and 5) Hornortho-klas earth.

The test crop was potato (Agria). In order to be able to treat uniformly, the application rate and concentration of the spray mixture was set at 150 l/ha (0.1%). The preparations were applied five times at relevant stages of plant development.

Figure 2: Preparation with orthoclase + soil or only Orthoclase (left) and pebble + earth or only pebbles (right)

Development: Unfolding of the third leaf (BBCH 13) - this spraying was repeated six days later due to subsequent rain at the end of the stand (BBCH 31), –, Be- the beginning of flowering (BBCH 60) and fruit formation/maturity (BBCH 70-80). Numerous criteria of plant development, disease and pest infestation, parameters of yield and quality formation, including ingredients, were examined.

The clearest result occurred at the early stage of flower set. According to Figure 3, all preparations resulted in delayed formation

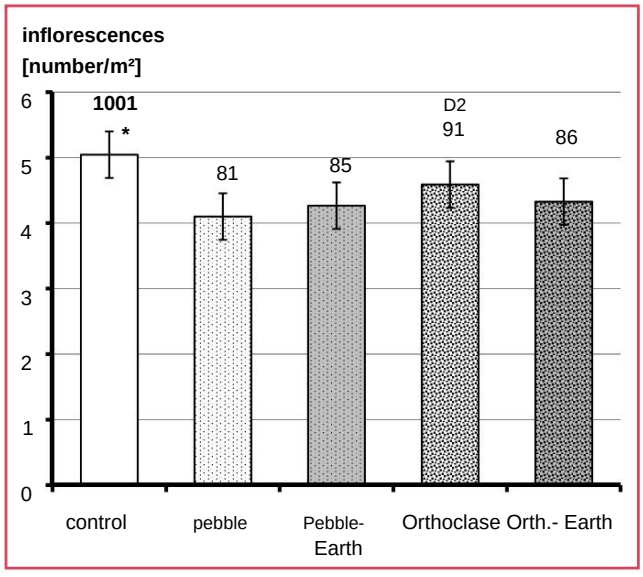

Fig. 3: Horn pebbles reduce the number of flowers in potatoes in all variants: Influence of treatment with various horn silica preparations on the number of blossomed inflorescences in potatoes. Df.hof 2010. *) Tukey ÿ 0.05; 1 relative values; 2 Dunnett a 0.05 significantly different from the control

Fig. 5: The crystal structure of pebbles (quartz or rock crystal, left) and orthoclase (right) differs

of inflorescences. At a relative 81% compared to the control (relative 100%), the development lag was greatest for the silica preparation,

Treatment options	Proportion of flowers in BBCH 61		
	%	rel.	
control, water	26.0	100	away*
Horn pebbles	22.0	85	b
Horn silica earth	32.0	123	a
horn orthoclase	20.0	77	b
Horn orthoclase soil	26.0	100	away

Table 1: Proportion of ears with the first visible anthers (BBCH stage 61, May 31) in percent of spring wheat cv. “Heliaro” depending on treatment with silica preparations. Dottenfelderhof 2011; Variants with the same letters do not differ.

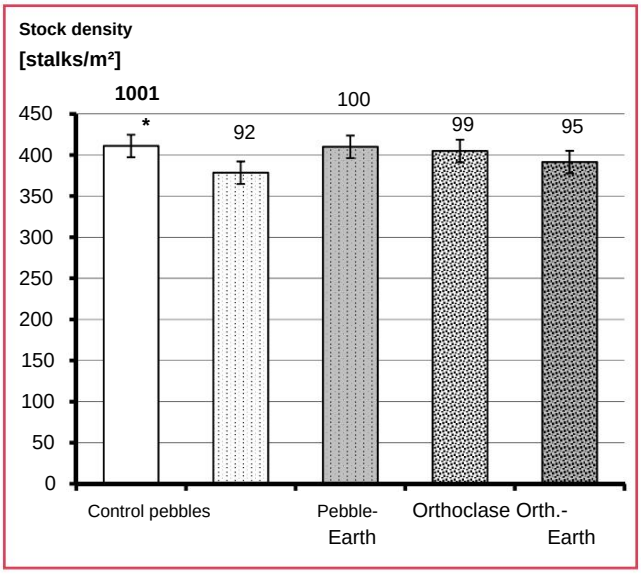

Fig. 5: Fewer spike-bearing stalks: stand density of spring wheat (number of spike-bearing stalks/m²) depending on treatments with silica preparations. Df.hof 2011. 1 Relative values, *) Tukey ÿ 0.05

At 91%, the orthoclase preparation was lowest and most consistent, as the difference to the control could be confirmed in the Dunnett test. The differences shown did not result in any significant differentiation in the disease and pest scores, in the yields and yield components such as tuber setting, as well as in the nutrient contents and withdrawals or in the vitamin C content and in the storage behavior of the tubers.

Only the image-creating methods according to Balzer-Graf (2001), which were used in all years, led to obvious differences in the blind test. However, this was not possible with raw potatoes, which are still very active physiologically and chemically after processing, but only with cooked tubers.
These results will be summarized at the end.

Field tests with pebbles or Orthoclase preparations for spring wheat 2011, 2012

As usual, quartz nodules came from the Dottenfelderhof and rock crystal from the nearby Taunus for these experiments. For the first time, orthoclase crystals from Feldberg/ Black Forest were used, which were provided by Prof. Wolfgang Schad.

the (Fig. 4). The specimens were prepared in spring 2010, buried at the Dottenfelderhof at the beginning of May and dug up on September 29, 2010. The experimental system remained the same and was installed in the field where the soil for the preparations was taken.

Spring wheat was chosen as the test plant, with many tried-and-tested test parameters being used. The company's own Heliaro variety was grown, which, as yellow wheat, has high levels of lutein, ß-Ca-rotin and zeaxanthin. The preparations were applied four times at relevant stages of plant development: three-leaf stage (BBCH 13), beginning of tillering (BBCH 21), beginning of flowering (BBCH 61–64), fruit formation/early milk ripeness (BBCH 73). The investigations included criteria for plant development, disease and pest infestation as well as parameters for yield and quality development.

The 2012 cultivation was expanded by a factor compared to 2011.

An initial treatment of the preparations as in 2011 was compared with a re-treatment of the replica of the experimental variants from 2011.

The system was therefore designed as a two-factor split system as a randomized Latin square with five repetitions.

stretches. The same preparations were used, but they were added to the ground again over the summer in 2011.

Somer wheat results 2011

As expected, no significant differentiations occurred in the field emergence with an average of 70% and the germination density with 270 plants/m². Dry, hot weather from March to May initially led to a heavy tillering of the plants with an average of 736 stalks/m² (tillering factor 2.6 = shoots/plant).

According to Table 1, the first serious differences appeared at the beginning of flowering. The proportion of ears with the first visible anthers on May 31st (BBCH stage 61) was significantly reduced in the horn silica and horn orthoclase preparations, whereas the two soil variants were not subject to this depression. On the contrary, the onset of flowering was strongly promoted by orthoclase soil with +23%, which could be statistically confirmed compared to pebbles and orthoclase.

In the course of further plant development, there was a strong reduction in the number of tillering shoots created to an average of 1.4 stalks bearing ears per plant. According to Figure 5, treatment with the usual silica preparation reduced the number of ears most significantly.
the stalks and therefore statistically differed from the untreated control, but also from the silica-earth preparation.

Despite the differences shown, the preparation treatments did not have a significant effect on the level of all parameters examined in the crop surveys, on numerous macro and micronutrients as well as secondary plant substances and parameters of seed quality.

nificantly. The trend in the yields according to Table 2 was that the promotion of vegetative growth through more or less all preparations came at the expense of the generative organ with reductions in grain yields. With the results achieved, the preparations showed their strongest influence on the compensation processes in plant development.
This raises the question of whether the early use of preparations at the three-leaf stage caused excessive vegetative development in the plants.

Spring wheat: Results 2012

When comparing the weather conditions to 2011, the temperatures during the growing season were also above the long-term average. In terms of precipitation, 2012 differed significantly from 2011 with above-average amounts of rain in the months of June and July. Together with sufficient rainfall in May, they had a very strong influence on yield formation. With an average of 55 dt/ha of grain and 36 dt/ha of straw, the yields were 22% and 53% higher than in the previous year. This is possibly a reason why there were no guaranteed yield effects from the preparations, even if the variants differed significantly.

In contrast, notable differences emerged in qualitative studies. On average over the two cultivation stages, the ß-carotene contents were generally increased by the preparations according to Figure 6. With the exception of silica soil, the significant increase rates were between 15 and 55%. Another result concerned the baking quality parameter gluten index, which is a measure of the adhesive strength (max. 100) or Softness (min. 0) applies. According to Figure 7, all treatments resulted

Treatment variants	Grain yield TM [dt/ha]	rel.		Straw yield TM [dt/ha]	rel.	
control, water	46.5	100	ns	22.8	100	ns
Horn pebbles	44.8	96		23.8	104	
Horn silica earth	45.6	98		23.4	102	
horn orthoclase	45.6	98		24.0	105	
Horn Orthoclase Soil	44.8	96		23.8	104	

Table 2: Grain and straw yield (dry matter) in dt/ha of spring wheat depending on treatments with silica preparations. Df.hof 2011

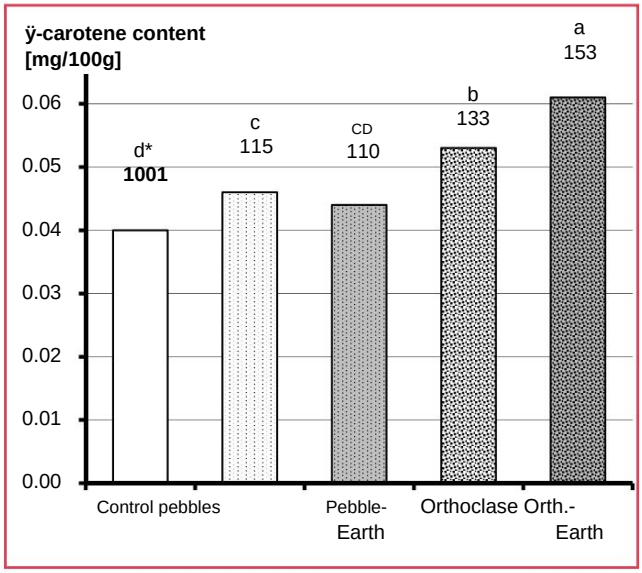

Fig. 6: ÿ-carotene higher after silica treatment: ÿ-carotene content [mg/100g] of spring wheat depending on treatments with silica preparations. Df.hof 2012. 1 Relative values, * unequal letters differ significantly: Tukey ÿ 0.05

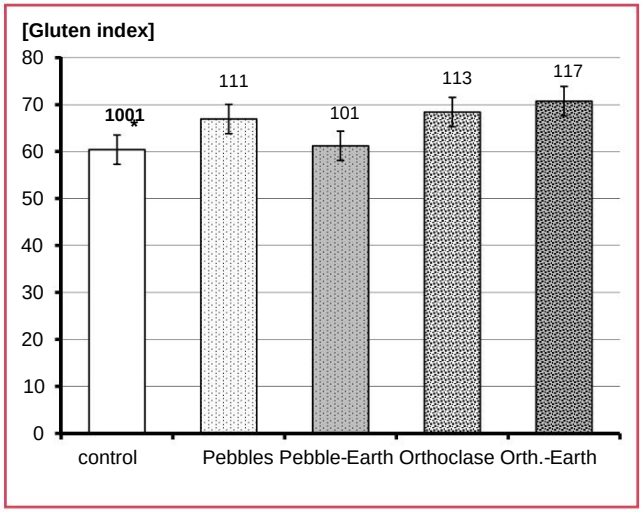

Fig. 7: Stronger gluten through silica preparations: Gluten index of spring wheat depending on treatments with silica preparations. Df.hof 2012.
1 Relative values, *) Tukey ÿ 0.05

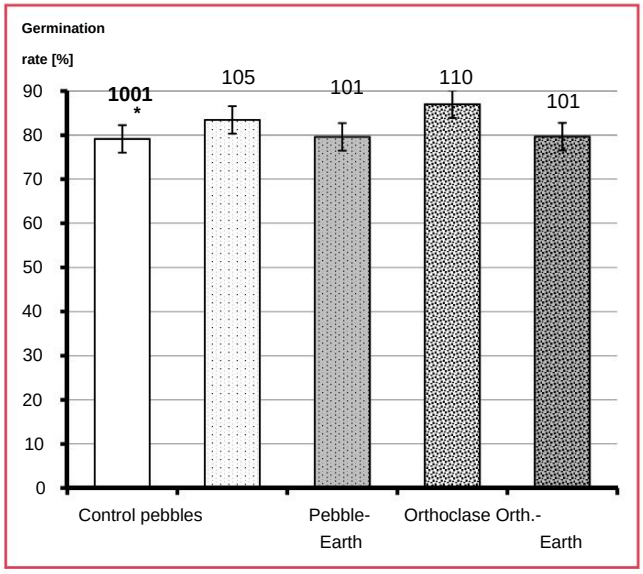

Fig. 8: Higher germination rate with orthoclase: Germination rate of spring wheat in the cold test (%) depending on treatments with silica preparations (re-treatment of the replica from 2011). Df.hof 2012. 1 Relative values, * Tukey ÿ 0.05

results in increases in adhesive strength, although only the orthoclase variants with 13 and 17% could be statistically verified.

Finally, the seed quality once again showed an influence of the preparation treatments, which were most clearly differentiated at the early times of the germination counts and increasingly leveled off.

Figure 8 shows the result of the germination test in the cold test at 5 °C of the retreatment test. According to this, the two pure preparation treatments seem to be more clearly differentiated from those with soil. While silica increased the driving force by 5%, orthoclase caused a significant increase of 10%.

Qualitative studies using image-creating methods

Using the methods of copper chloride crystallization and rising image, partly also a circular image chromatogram according to Balzer-Graf (2001) by J. Fritz and G. Mergardt, as well as the investigation of the effect sensor system according to Schmidt (2010), a differentiation was achieved in blind studies Treatment options. Only the results of the image-creating methods are discussed here, the results of which were available for all years. These are shown in an overview in Table 3 and in Figure 9 a–c. After that, the control variant with water - especially with potatoes - turns out to be very negative, whereas the usual pebble treatment brings about the greatest improvement in the quality of vital forces. Only in the study of wheat from the 2012 harvest did clear differentiations between all individual variants emerge in the average of the samples from new and re-treatment of the replica. There are indications that treatment with ortho-clasp preparation does not achieve the effectiveness of the silica preparation in these studies.

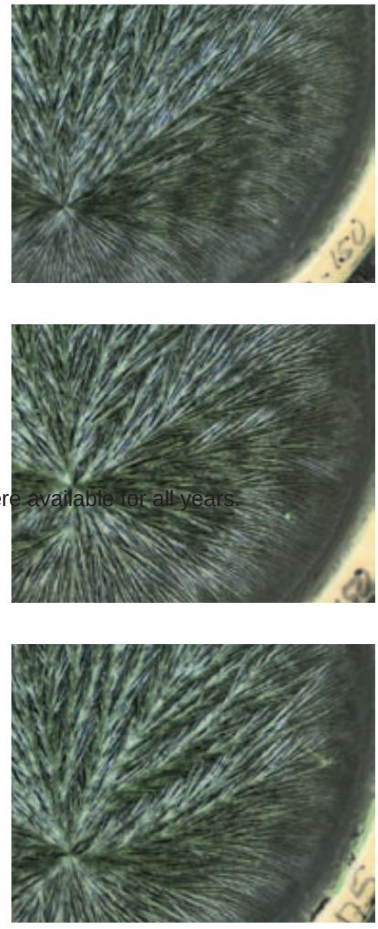

Fig. 9 a to c: Different vital quality: copper chloride crystallization of the 2012 spring wheat with control (water (top), horny silica (middle) and horny orthoclase (bottom)

Conclusion: greater differences in vital quality than in cultivation

It is striking that, in contrast to early preparation trials, there are only a few significant results in the agronomic properties. This could have several causes. On the one hand, confirms

It turns out that the preparations have a greater influence on the compensation processes in the course of plant development and thus have a leveling effect. On the other hand, this may be due to the fact that the experiments took place on areas that had been farmed biodynamically for many years (>52 years) and thus the

Letter from G. Wachsmuth on behalf of Rudolf Steiner to Count Keyserlingk July 10, 1924: "...As far as the practical information is concerned, Dr. Steiner during the I course concerns, would like to take this opportunity to add an addition that Dr. Steiner stated this in a subsequent discussion here. Mr. Doctor had stated at the time that cow horns should be filled with finely ground orthoclase feldspar, pebbles. When we were discussing where we could get a larger quantity of this from, Dr. said Steiner it It is sufficient to use a medium-sized crystal of this type in fine crushed state with something of Mix it with the soil, knead the crystal form, which is later to be treated with this substance, i.e. the finely ground horns should flour into the relevant arable soil if possible lightly and to fill the ground over the summer, as was These then best be covered with pitch on top stated at the time. I would be very grateful if you the if You would kindly inform the other members of the experimental ring about this through the Koberwitz office..."

	Potatoes 2010	Spring wheat 2011	Spring wheat 2012
	"Image-creating examination Dr. J. Fritz/Bonn SB: climbing image; KB: Crystallization image"	"Image-creating investigation (SB, KB) Dr. J. Fritz/Bonn"	"Image-creating investigation (SB, KB) G. Mergardt/Witzenhausen"
Control (Water)	SB: Coarsest, stiffest images with the least amount of insufficient ripening. Tension. KB: Strongly contoured, rigid needle pulls, little yellow, little brightness, low substance effect, high aging.		Generally: Very fine needle structure, radiant to flower-like characteristics, high substance effect, center point-like and not powerful in its creative power.
Horn pebbles	SB: Finest and liveliest pictures with the most inner tension. KB: Brightest and yellowest needles, even finer and more lively than siliceous earth.	Best, most harmonious maturation.	Strengthening impulse, plus mobility and integration of the overall images, while maintaining or increasing the radiance. Formation of image elements typical of wheat.
Horn silica earth	"SB: Finest and liveliest images with insufficient ripening, no differences, clear mineral components, effective force reduction for control and ortho-impulse, change towards seed and wheat-typical, most internal tension. KB: brightest and yellowest needle pulls."	class earth.	Radiance and form power are retained.
Horn orthoclase	SB/KB: Between control and pebble variants, ranking ahead of orthoclase soil.	compressed in the short approach.	Similar control, larger, clearer crystal, good maturation, slightly lization center: Strengthening impulse and gained form power.
Horn orthoclase soil	SB/KB: Between control and pebble variants, in the ranking behind orthoclase.	Insufficient ripening.	Clear mineral components, effective force impulse, change towards seed and wheat-typical, loses some radiance and form, appears somewhat static.

Table 3: Influence of treatment with variants of horn silica and horn orthoclase preparations on the vital quality of potatoes and spring wheat using imaging methods. Dottenfelderhof 2010–2012

effects were compensated. It is also conceivable that the stress conditions (ozone, UV radiation, ubiquitous environmental pollution) to which plants are exposed today led to a reduction in effectiveness. On the other hand, it may be due to the methods used, which were primarily geared towards the relevant agricultural parameters. Nevertheless, the individual significant differences should not be underestimated, which were mainly found in plant development and in qualitative parameters.

On the other hand, it is with Examination of vital quality through image-creating methods as well as educational research in blind tests made it possible to assign the variants and describe them in a differentiated manner. Afterwards, a sequence of treatments emerged with regard to vital quality: horn silica preparation > horn orthoclase preparation > horn silica-earth preparation > horn orthoclase-earth preparation.

The results presented do not allow any statement to be made about a general preference for quartz or orthoclase or a type of production. In order to obtain clues for a specific application of the various preparation forms of the preparation, further cultivation experiments with various crops are carried out also strive for in-depth investigations using various biodynamic methods.

The authors propose using the new method of investigating the "effect sensory function" using the "psychological test for food effects" (Geier et al. 2016) to carry out studies with the different silica preparations in order to obtain further information for assessing the food quality influenced by the applications. I

literature

Balzer-Graf U. 2001: Vital quality - quality research with image-creating methods. Ecology & Agriculture 117.1, 22–24 • Bosse D. 2009: On the nature of orthoclase with regard to its use in horn silica preparation. Frumenta, Arlesheim (CH) • Geier U., Büssing A., Kruse P., Greiner R. & Buchecker K. 2015: Development and application of a test for food induced emotions. Food Quality & Preference (submitted). • König UJ 1999: Results from drug research. IBDF series of publications Vol. 12, ed. Forschungsring f. Biol.-Dynam. Economics, Darmstadt • Rykart R. 1989: Quartz Monograph. 2nd edition Ott Verlag, Thun (CH) • Schad W. 2011: Rudolf Steiner's relationship to natural science. In: Uhlenhoff R.: Anthroposophy in history and the present. BWV Berliner Wissenschafts-Verlag • Schmidt D. 2010: Life Forces – Formative Forces. Methodological principles for researching living things. Verlag Freies Geistleben, Stuttgart • Senger C. 1987: Effects of biodynamically prepared quartz on the growth and quality of various cultivated plants. Diss. Göttingen • Spieß H. 2009: Research results of horn orthoclase preparation versus horn silica as well as various preparations on bush beans in container experiments. Lecture International Working Group on Biodynamic Preparations, 23.– October 25, 2009, Goetheanum, CH-Dornach • Spieß H. 2011: On the effect of biodynamic preparations. Evidenced research results – an overview. Live. Earth 2, 44–48 • Steiner R. 1924: Humanities basics for the prosperity of agriculture. GA 327.Rudolf Steiner Verlag, 1979, CH-Dornach • Wachsmuth G. 1924: Copy of a letter to Count Carl Keyserlingk. Dornach July 10, 1924. Rudolf Steiner estate administration, CH-Dornach