

A phenomenological approach to garlic cultivation in soil with and without mulch.



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Abrevations:

c/ or c/a: with mulch

s/ or s/a without mulch

Var. or v.: variety

Motivation

After starting the Jahreskurs or annual year, I was pleasantly surprised to discover Goetheanism as a method of qualitative analysis of reality. This current, also called Phenomenology, was taken from Steiner's thought and is therefore closely related to Biodynamic Agriculture, which aims to base the development of agriculture on observation and action, or in other words, the will of man to care for and develop plants, soil, animals and himself.

The reason for carrying out my work is to learn Goetheanism in practice. Goethe said:

"Thus, the true botanist must not be moved by the beauty or usefulness of plants: he must investigate their formation, their relationship with the rest of the plant kingdom. As soon as we look at an object in relation to itself and in relation to others and do not immediately desire or detest it, with calm attention we can quickly form a fairly clear idea of its parts and their relationships."

I find it particularly interesting to apply this method within the framework of the annual project at the Landbauschule.

At the Landbauschule Dottenfelderhof, people are working already with garlic cultivation and different varieties under different management conditions. I would like to learn about this cultivation and Goethean Phenomenology. In order to get an approach, here is a brief summary of both topics.

1. Introduction

1.1 Goethean Phenomenology

For Rudolf Steiner there is a path of development open to every human being with the capacity to think and feel until reaching the perception of the invisible. He recognizes the similarity between the conception of the world and the scientific theory of the Goethe's vision of the world. In this sense, Goethe refers the understanding of observable phenomena to their ideal essence.

The current scientific paradigm reduces problems to limiting solutions, only useful for a specific situation, causing problems to be transferred to later and elsewhere. The holistic Goethean phenomenological approach includes the observer along with the observed as an object of research and experimentation in the natural sciences.

The experiment as a mediator between the subject and the object is the foundation of phenomenology. Only our understanding or our interpretation of the observed phenomenon can fail. Nothing external to us can force us to accept an explanation or proof except our own feeling of truth.

To summarize, Phenomenology is based on:

1. Seeing the now of the observed phenomenon.
2. Seeing the becoming or the spatial/temporal relationship between the parts or manifestations of the phenomenon.
3. Developing the capacity to know through contemplation. We find ourselves “seeing the being” of the observed phenomenon or object. The practical interest for the farmer is to recognize and manage the environmental imbalances that a crop plant is experiencing during its development. In this way, a diagnosis can be made and, if necessary, measures can be applied to restore the dynamic development process undertaken by the plant. For example, the application of Biodynamic Compost Preparations to a pile of manure, to considerably improve its capacity to play its role in regulating the process (adequate transformation and avoiding or reducing aerobic putrefaction).

Other examples for the life of the farmer and for people in general are those that this approach responds to:

- A respectful and environmentally sensitive management of land use.
- It establishes a bridge between humans and nature.
- It clarifies the concepts: holism, organic, health, vitality, quality of life, etc.

To conclude, the Goethean phenomenological approach in natural sciences in general and in agriculture can contribute to understanding the intrinsic vital processes of living nature, “the language of nature”. In a clear and critical way, the scientific method appears as a tool for the development of humanity, perception of morality or ethics that arises from the object of research.

Regarding garlic, there is not much information about its cultivation in Germany. At the Landbauschule Dottenfelderhof e.V., studies are already being carried out on garlic cultivation and different varieties under different organic and biodynamic management conditions used in this type of agriculture. Below is a summary of the most important information collected so far regarding different aspects of the market, cultivation and organic farming in Germany.

1.2 Situation of the garlic market in Germany

According to a market study of garlic in Germany (Gateway & Partners 2018), there are clear trends in the population towards greater consumption of garlic, as it is perceived as a food with medicinal and anti-cancer characteristics, consumed in Asian and Mediterranean cuisine.

1.3 Organic Farming in Germany

The number of hectares under certification has been increasing recently. In 2020, 10.3% of the total hectares of agricultural land were certified organic, i.e. 1.7 million hectares (German Federal Ministry for the Environment 2022).

1.3.1 Biodynamic Agriculture

The birth of Biodynamic Agriculture began in 1924 when Dr. Rudolf Steiner gave a series of eight lectures aimed at farmers to solve soil fertility problems, among others. Fundamentally, this type of agriculture understands the farm as a system called “agricultural organism” or “agricultural individuality” composed of elements such as soil, animals, plants, forests, streams, human systems and local climate. This system reduces external inputs, recycles and seeks to take advantage of resources with the aim of being truly economical and efficient in the use of resources.

A fundamental aspect to address is soil fertilization to balance and vitalize it. It consists of vitalizing the soil, stimulating the biotic complex. It is intended that fertilization be done with organic matter such as: compost, manure, green fertilizers, and biodynamic preparations. These preparations provide nutrients and strength to the soil, stimulating a greater quantitative and qualitative production of crops. The soil tends towards an eternally living organism, for example, from the application of compost and green manure.

The following practices can be applied to plant and soil life:

- Windbreaks (trees and shrubs): they provide additional benefits to the landscape, shade, water reserve in the soil.
- Mulching: reduces evaporation on the surface, protects against solar radiation and heat, reduces erosion by rain, protects soil life, and reduces weeding.

In Biodynamic Agriculture, we speak of cosmic effects, that is, the productivity and quality of plants results from the influence of terrestrial and cosmic effects, such as the influence of the movement of the sun and lunar rhythms on plant growth.

As mentioned before, a very relevant aspect is also the Biodynamic Preparations. These were developed based on the indications of Dr. Rudolf Steiner in the aforementioned Agricultural Course. These are organic and mineral materials that through a fermentation process or rather transformation acquire specific qualities.

Among the Spray Preparations are:

- P500: cow dung in the horn. It is applied to the soil, stimulating vegetative growth.
- P501: Ground silica (mixed with water) in the horn. This is applied to plants, stimulating the formation of grain, fruit and plant health. It also promotes a balance of growth in a vertical direction, in rainy seasons or when too much P500 has been applied.

The Compost Preparations are applied to the compost pile to promote its transformation properly. In its composition there are plant and animal materials.

These are:

P502 Yarrow Preparation,

P503 Chamomile Preparation

P504 Nettle Preparation

P505 Oak Preparation

P506 Dandelion Preparation

P507 Valerian Preparation

With regard to biodynamic products and their quality, it can be said that many experiments have been carried out that they have confirmed benefits such as better flavour and post-harvest preservation, as well as high biological value, etc., and this gives them a greater value in the market.

This form of agriculture has been developed and tested with multiple experiments at the Institute for Organic Agriculture Research or FIBL; demonstrating a positive influence on soil fertility, biodiversity and people involved in agricultural tasks.

Other advantages: the reduction of energy used can range between 30 - 50%, and the reduction of pesticide use by 90% as Mäder and his team at DOK-Versuch found.

In view of the current crisis that agriculture is going through, which is ecological, economic and social, Biodynamic Agriculture proposes a solution to these problems with ethical principles committed to deepening the knowledge of nature and the essence of the human being.

1.3.2 Soil tillage in organic and biodynamic farming

Soils are constantly changing and interacting with the environment. If continuous tillage (mainly vertical, and occasionally horizontal) of soils is considered, it harms the formation of humus, but favors the activity of soil microorganisms, and therefore favors mineralization, which is important for vegetable cultivation.

1.3.3 Weed flora in organic and biodynamic systems

Weed flora is of great importance to take into account in crop management. They compete for space, light, water and nutrients, and reduce crop yield.

Specifically in organic and biodynamic management, this problem is important due to the prohibition of the application of synthetic herbicides in their regulations. Therefore, preventive measures are applied, for example, the combination of crops, cover crops and mulches and manual and mechanical mowing and weeding.

1.4 Mulching and soil temperature

Several studies have been conducted on mulch and its influence on soil temperature; for example, organic mulch maintains a moderate soil temperature during cultivation, improves soil structure by reducing soil tillage, allows irrigation water to filter through, and serves as soil fertilizer after cultivation is complete.

It also helps maintain soil moisture for longer period of time, attracting fauna and micro fauna under the mulch, increasing soil fertility in general. Acting as a self-regulator of crop diseases and pests. This type of mulch is required under Demeter certification standards.

1.5 Garlic and its Eco physiology

For good garlic crop management, it is necessary to know how the plant develops during its life, and thus influence the development factors and reach the stated objective, such as the highest yield. Below are the stages of development of the garlic *Allium sativum* species:

- 1) Budding: at the end of summer and beginning of autumn when temperatures begin to drop.
- 2) Growth: occurs in autumn and winter, mainly in the root. As winter ends, temperatures begin to rise, so the vegetative apex captures these stimuli and the leaf mass begins to develop very quickly. At the end of winter, when temperatures increase, along with the photoperiod (increase in day length), the growth of the apex changes, that is, the leaf mass no longer grows but the inflorescence (in varieties that have inflorescence). After this change of apex, the reserve leaves are defined and bulb formation is outlined.
- 3) Bulb formation: once the cold hours have lapsed, another environmental signal is given that will initiate the filling of the bulb, and this is a critical value of day's length. That is, the photoperiod (length of the day) is a variable that is directly related to latitude and is constant over time, and it is what will determine the harvest date of a crop will always be the same, regardless of when the bulblets were planted. Another condition that occurs is the increase in temperatures, mainly at night.
- 4) Senescence: occurs with the lengthening of day light and increase in temperatures. The leaves begin to senesce and to translocate growth inhibitors that induce the pre-dormancy stage.
- 5) Dormancy: This occurs when the plant is harvested (yellowing of the first leaves) and in natural conditions will continue until late summer, early autumn when temperatures begin to drop again.

2. Project objectives

In my project I would like to find out the qualitative and quantitative characteristics of four garlic varieties under the climatic conditions at Dottenfelderhof with mulched soil and bare soil using the Goethean method.

Regarding the cultivation of garlic in Organic and Biodynamic Agriculture, this work is directly related to the work that is already being carried out at the Dottenfelderhof farm regarding the cultivation and management of garlic, evaluation of varieties and improvement in Organic – Biodynamic Agriculture.

Specifically, the aim of the work is:

1. To measure the yield of four garlic varieties from the Gatersleben germplasm bank that are in their third year of cultivation and that come from bulbils.
2. To compare the yield and its growth variables in mulched and unmulched soil.

3. To put the phenomenology into practice and learn how to manage the crop based on it and describe this varieties in this conditions.

3. Method

Through collected observations and notes from garlic plants developments of four varieties carried out twice a week, since their planting on 20/10/2023. Observations of the field conditions surrounding the trial will also be taken into account. In this way, an idea can be obtained about the development of the varieties under these field conditions.

The propagation material consisted of four varieties obtained from the Gatersleben germplasm bank in 2021 (little bulbs from the aerial part), cultivated in their third year at Dottenfelderhof.

For this purpose, a plot design was carried out with the available propagation material in a mulched bed and another in bare soil in Feldgarten, where vegetables are cultivated.

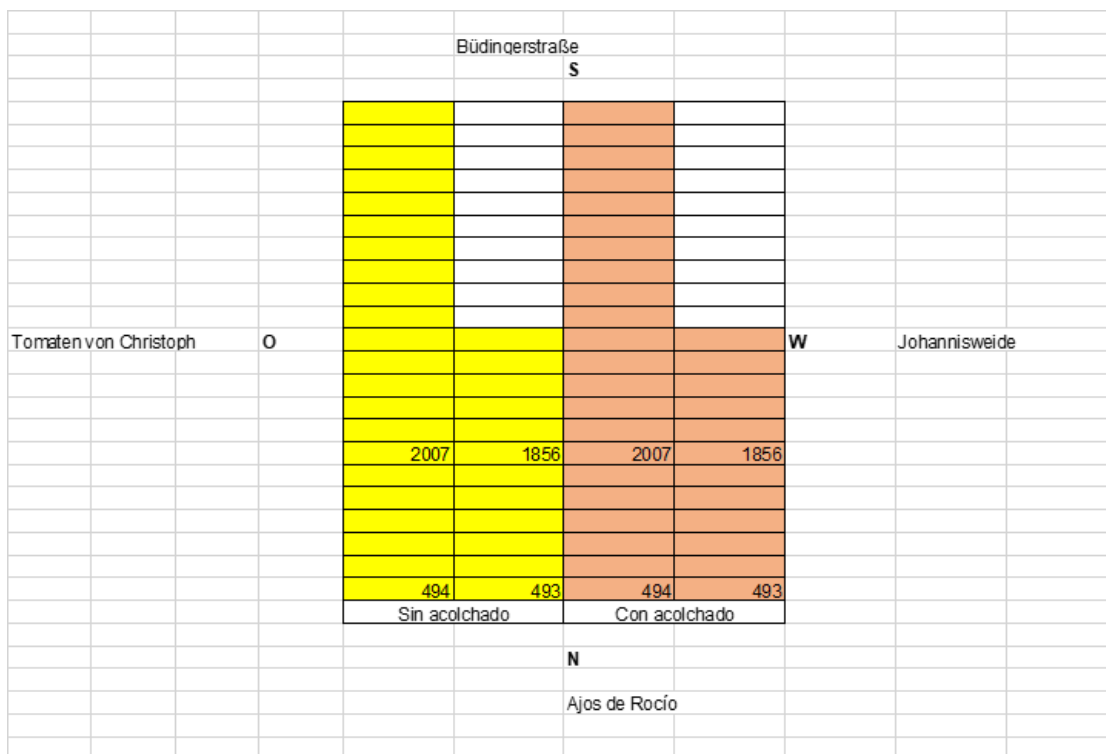


FIGURE 1 PLANTING PLAN

4. Results

4.1 Field observations

Field visit, 08/12/23

Visit at 15:30h. Waning moon phase, sign of the moon Libra, in the constellation Virgo.

No mulching:

Variety 494 has barely begun to sprout, height of 1 cm and 0.5 cm from the plant, in the entire line the number of garlic cloves that have sprouted is very low.

There are no weeds on the soil surface. We can observe snow on variety 494 planting line, and abundant humidity on the surface, more than 4 cm deep.

Variety 2007 has sprouts less than 1 cm high, the number of sprouted garlic is very low.

Variety 493 sprouting from 1 and 0.5 cm, very low number of seeds in the planting line have sprouted.

Variety 1856 c/a without sprouting in the planting line, little grass on the surface, abundant humidity.

In mulch:

V. 494 and 2007 have not sprouted at all. No grass right on the planting line. Little snow on the mulch and no snow at the planting line.

Variety 493 c/a we observed garlic sprouts, varying numbers of sprouts, heights 2 – 3 cm, no grass on the surface and high humidity in the soil.

It can be seen that the snow on the straw mulch melts faster than on the soil of the bed without mulch.

The day was very cloudy, with abundant low-altitude fog, ambient temperature of 1 to 2°C. No wind and no rain. The sensation was of high humidity in the air.

Field visit, 01/02/24

V.493 s/a and v.494 s/a: growth has been between 2 and 4 cm high, there are no weeds on the surface. Abundant soil moisture, maintaining good structure.

V.2007 c/a: growth between 3 and 4 cm high, practically uniform, germination of all or almost all cloves. V.2007 s/a has little grass on the surface. V1856 sprouting of all cloves. Height plants between 1-3 cm with abundant soil moisture.

V.494 c/a: height 2-4 cm. Sprouting of fewer cloves than v494 s/a, same growth in height in both varieties. Abundant soil moisture. Compact soil structure.

v493 c/a: 100% sprouting of the cloves. Height 3-5 cm. Some yellow leaves at the tips. No grass on the soil surface. Same height growth as v493 s/a.

Days between clouds and clearings, rained the night before, quite wet soil, no puddles of water, the ground absorbs rainwater, NE wind, temperature around 5°C, low ambient light.



FIGURE 2 VIEW OF SPROUED VARIETIES WITHOUT MULCHING

Field visit 20/2/24 at 4pm.

V.1856 s/a: height 8 - 9.5 cm.

V.493 s/a: height 10 - 12 cm, 100% sprouting of bulbils or cloves.

V.494 s/a: little grass on the surface, abundant soil moisture, 5 to 6 cm deep, plants height 10 - 12 cm.

V.2007 s/a: little grass on the soil's surface, 12 to 14 cm plant height, thin leaves with erect vertical growth. Thinner leaves drooping towards the sides, thin stem in v1856 and thicker leaves.

Daytime ambient temperature of 7°C, low wind speed, gray and clear clouds, no rain throughout the day.

Mulched bed: varieties height growth, between 10 and 12 cm in the 4 varieties, little grass on the surface, in the bed as well as in the planting line.

V.494 c/a: thin leaves and thin stems, greater heights in unmulched beds, leaves between 11 and 13 cm long and these open towards the sides of the plant.



FIGURE 3 V.1856 WITHOUT MULCH



FIGURE 4 V.494 WITHOUT MULCH



FIGURE 5 V.1856 WITH MULCH

Field visit 1/3/24 at 3pm

In the varieties without mulch there is no grass on the soil's surface, high humidity in the soil, many earthworms, in the varieties with mulch the height of the plants is slightly lower than in the varieties without mulch. Heights of 7 - 8 cm, stem diameter between 1 and 0.5 cm.

Varieties without mulch growth slightly greater, 6 - 8 cm heights, little grass on the surface, less earthworms in the soil, stem thicknesses of 0.5 - 1 cm, dark green leaves.

Day climate between clouds and clearings, ambient temperature 8 - 10°C, no wind, humidity on the soil surface, no rain.

Field visit 20/3/24 at 13 pm

V.494 s/a has grown more in height than v.494 c/a, in v.493 the same situation is observed: the s/a variety has grown more than the same variety c/a, we see little grass on the soil surface, low humidity on the soil.

V.2007 similar plant growth in both treatments, and slightly higher plant growth without mulching.

V.1856 s/a has grown more than the same variety c/a, little grass and humidity on the soil.

Sunny day with some clouds, no wind, with temperature 10°C.

Field visit 26/3/24 at 12 pm

We observed the plants height of the four varieties with and without mulch and they are very similar, except for v493 c/a where the plant height is lower than v493 s/a, of this variety in both treatments the growth heights are 12 cm high. Stem thickness 1-1.4 cm.

V.2007 s/a plant height 12 cm greater than the same variety c/a, v.1856 s/a plants are taller than v1856 c/a, 2-3 cm higher than the same variety c/a. In these varieties the green color is darker, some tips of the leaves are yellow, but very little.

In general: in the s/a varieties the leaves are yellowish-green, in the c/a variety the leaves are greener.

Low soil surface humidity, temperature 10°C, cloudy sky with abundant visibility and light breeze.



FIGURE 6 V.493 AND v.494 WITH MULCH

Field visit 25/4/24 at 3 pm

V.494 c/a and s/a presented green leaves color, 1st and 2nd leaves are yellow, 3rd, 4th, 5th, 6th leaves fall to the sides.

V494 c/a and s/a plants are similar height, soil has moisture at depth 5 - 7 centimeters.

V.493 s/a appearance of good plant vitality, vertical growth of leaves, leaves in good condition, some yellow, but in general in good condition, and similar heights, leaves less fallen to the sides, low humidity on the soil surface and medium humidity at depth.

V.2007 s/a are quite healthy plants, with similar heights, and vertical growth, leaves not fallen to the sides, the stem a little more yellow than the leaf, giving an appearance of vitality, low surface humidity and medium humidity at depth.

V1856 s/a we see plants of similar height, some leaves fall to the sides, some yellow leaves, low soil humidity and medium humidity at soil depth. High vitality, check height and width of leaves in the table of data collected in the field.

V.494 c/a heights lower than v494 s/a; in general the plants also have a darker green color, the leaves fall less to the sides: Leaves 1° and 2° are greener than v494 s/a, and their appearance is also healthier, and their height is lower.

V493 c/a in general the plant green colour is more intense than the v493 s/c, the stem diameter is thicker than the same variety s/a, the leaves are very slightly yellow without fungus and erect bearing.

V.2007 c/a similar plants heights, intense green colour leaves, yellow tips, more yellow tips than the v2007 s/a, leaves drooping to the sides, this characteristic is greater than in the v2007 s/a, high vitality, with intense green, wide leaves, check the height and width of the leaves in the table of data collected in the field, less colour contrast between the stem and the leaf than in the v2007 s/a.

V.1856 c/a in general similar plant heights, deep green, we don't see any yellow on the leaves, no fungus, high vitality appearance compared to v1856 s/a, (less green and more yellow on the leaves in general), vertical leaves growth is similar to the same s/a varieties, leaves drooping slightly to the sides,

Climate is cloudy to sunny, dark and light clouds, light intensity is medium high, low breeze intensity, the mulched garlic bed is sheltered from the wind, the grass has grown quite a bit outside the planting bed, day temperature 10 °C, cold wind, medium to low ambient humidity.

Field visit /27/4/24 2 pm

In v1856 c/a we observed that the stem is wider than that of the same variety s/a, in v1856 c/a darker green leaves and the stem compared to the same variety s/a. In general the tips of the leaves have a yellow color, especially the 1st and 2nd leaves, which also occurs in the s/a variety. The soil looks darker, which retains moisture on the surface and in depth.

In v1856 the surface of the soil is more yellowish, dry, there is moisture of 5 - 7 centimeters in soil depth. In general the thickness and length of the leaf is similar in the two treatments of v1856. Check the height and width of the leaves in the table of data collected in the field.

V.2007 c/a and s/a we see plants are similar heights, perhaps the length of the leaves are greater length in the c/a variety, there is less contrast in the color of the green of the leaves and the stem, than in the v. s/a, in the latter the stem is seen more light green towards white yellow and the leaves are light green, the height of the v. s/a is slightly lower than the v. c/a, high vitality of this last variety, the leaves do not fall to the sides in both varieties treatments.

V494 c/a shows low moisture on soil surface, at depth the moisture is medium, the 1st and 2nd leaves look yellowish, height of all plants are similar, greener in v494 c/a than in this same variety s/a.

Stem thicknesses are similar in v494 and the leaves fall to the sides for both treatments c/a and s/a. The v c/a has similar heights of all plants with high vitality.

V.494 c/a has yellowish leaves 1 and 2, and the rest of the leaves have yellow tips, some fungus on the leaves, especially in the variety s/a.

V2007 c/a and s/a, height of the plants is similar, and in the c/a treatment the length of the leaves is greater, the green is darker and there is less color contrast between the stem and the leaf. In the 2007 s/a, a dark green color is seen and the stem is lighter in

color. In general, they have a high vitality and health and the leaves do not fall laterally in both c/a and s/a treatments.

V.494 c/a shows low humidity on the soil surface and high humidity in the soil depth, leaves 1 and 2 look yellowish, the height of all the plants is similar, the darker green of v494 c/a, than this same variety without mulch.

Var. 494 s/a, presents yellowish leaves of the 1st and 2nd, some yellow tips and fungus, especially in v. s/a.

Days of clouds and clearings, the sun shines between the clouds, high luminosity, pleasant breeze, temperature between 10-12 °C, low ambient humidity.

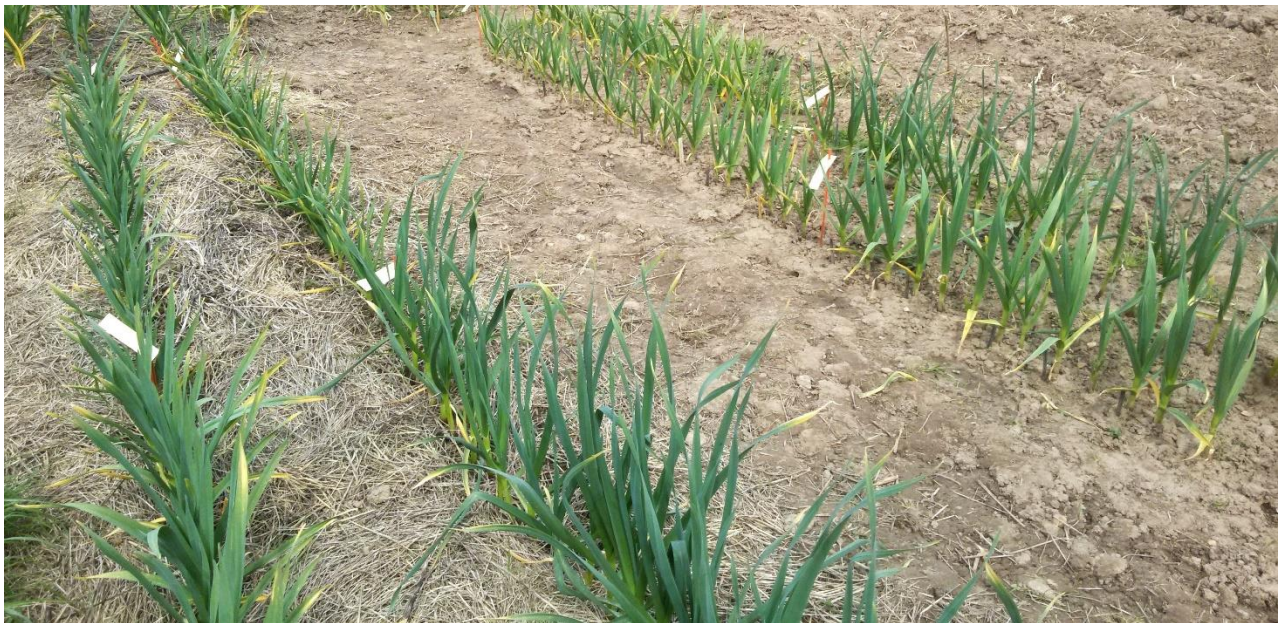


FIGURE 7 FROM LEFT TO RIGHT FROM TOP TO BOTTOM: 493 AND 494 WITH MULCH, 493 AND 494 WITHOUT MULCH. BELOW: 1856 AND 2007 WITH MULCH AND 1856 AND 2007 WITHOUT MULCH

Field visit 20/05/24 2:00 p.m.

V.494 s/a was found to be 15 cm tall, 1.3 cm stem wide, with dark green leaves and the plant generally looking quite healthy, with leaves open to the sides, few weeds on the soil surface, and abundant moisture on the soil surface and in depth. Yesterday was a day of heavy rain.

V.494 c/a was shorter than v494 s/a, with an even darker intense green color leaves than v494 s/a, leaves open to the sides, stem thickness less than v.494 s/a, healthy appearance.

V493 s/a plant height is less than v493 c/a, stem diameter is less than 1 cm, height is similar to v493 c/a, dark green leaves without fungus, and little weeds on the soil surface, and abundant moisture on the soil surface and in soil depth.

V.493 c/a overall health is greater than s/a, greater plants heights, darker green color leaves, no fungus, no yellowing of the leaves, stem thickness 1 – 1.5 cm, plant heights between 12 – 15 cm tall, erect leaf growth, no grass seen on the soil surface, abundant moisture under the mulch and on the soils surface.

V.2007 s/a has even heights of 15 cm, good general health, leaves growing vertically, stem thickness 1 - 1.4 cm, dark green stem, perhaps the stem more yellowish than the leaves, little grass on the soil surface, abundant humidity on the surface and depth.

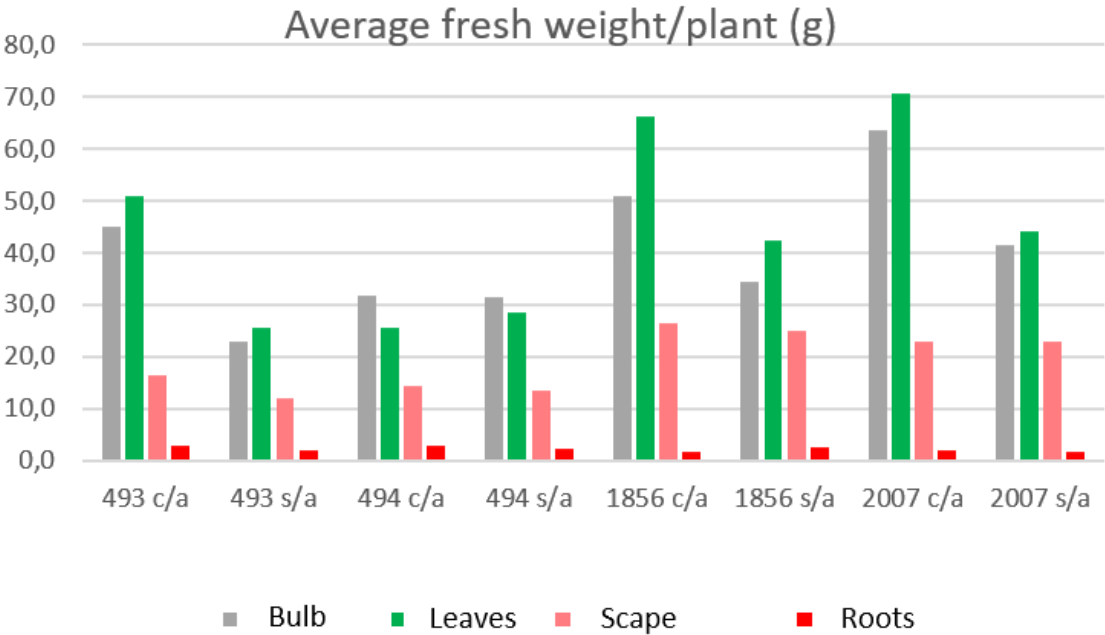
V.2007 c/a is seen to be perhaps slightly greater in height than v2007 s/a, thicker stems 1 – 1.5 cm, very similar plants height, darker green of the stem and leaves than v2007 s/a, dark green leaves with some yellow tips, leaves slightly wider than v2007 s/a with an erect habit.

V1856 s/a leaves are darker green in general, they look good, plants height 12-15 cm, stems 1-1.5 cm, leaves open to the sides, abundant moisture in the soil, few weeds on the surface of the soil.

V1856 c/a leaves are wider than v1856 s/a, the stem thicker than the same variety s/a, plants height 15 cm, dark green stem and leaves, some leaves grow to the sides, with a very healthy appearance of the plants, abundant moisture under the mulch and no weeds on the soil surface, the stems thickness range from 1-1.5 cm, robust plants.

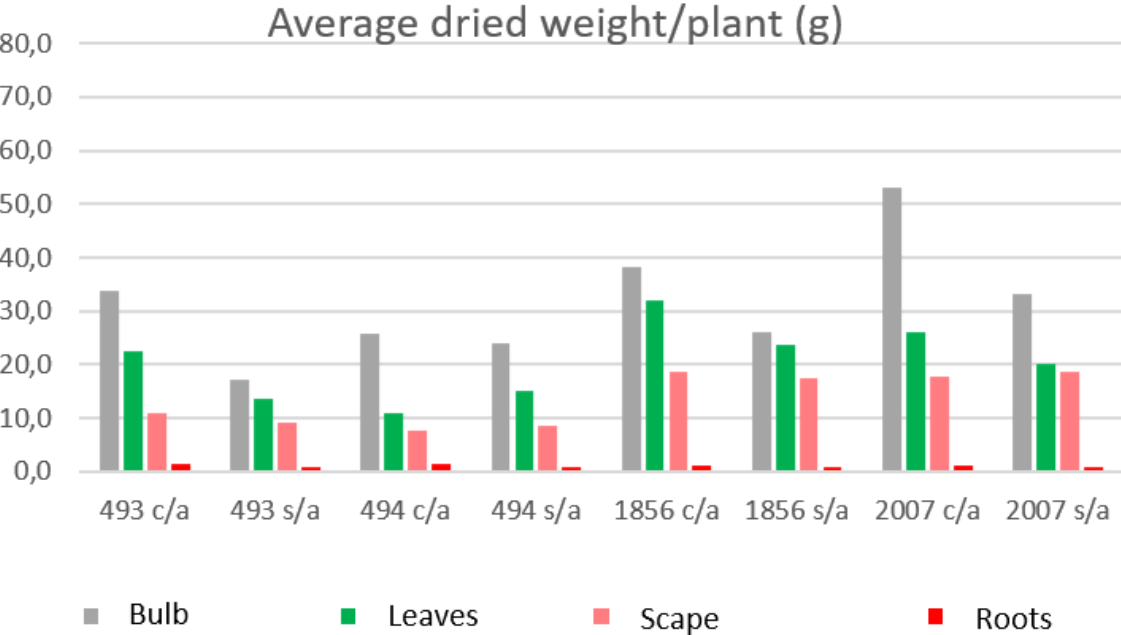
The day dawned with a cloudy sky, at this moment the sky is free of clouds and the sun is shining, temperature of 20 °C, low intensity breeze wind, abundant moisture in the soil.

4.2 Collection of average weights per plant results in fresh and dry conditions for different varieties with and without mulch.



s/a: without mulch c/a: with mulch

FIGURE 9 AVERAGE FRESH WEIGHT PER PLANT IN BOTH TREATMENTS



s/a: without mulch c/a: with mulch

FIGURE 8 GRAPH 9 AVERAGE DRY WEIGHT PER PLANT IN BOTH TREATMENTS

4.3 Images of the studied varieties with and without mulching.



FIGURE 10 VAR. 2007 AND 1865 WITHOUT MULCH: BOTH WITH ERECT HABIT



FIGURE 12 VAR. 493 WITH MULCH



FIGURE 11 VAR. 494 AND 493 WITHOUT MULCH.

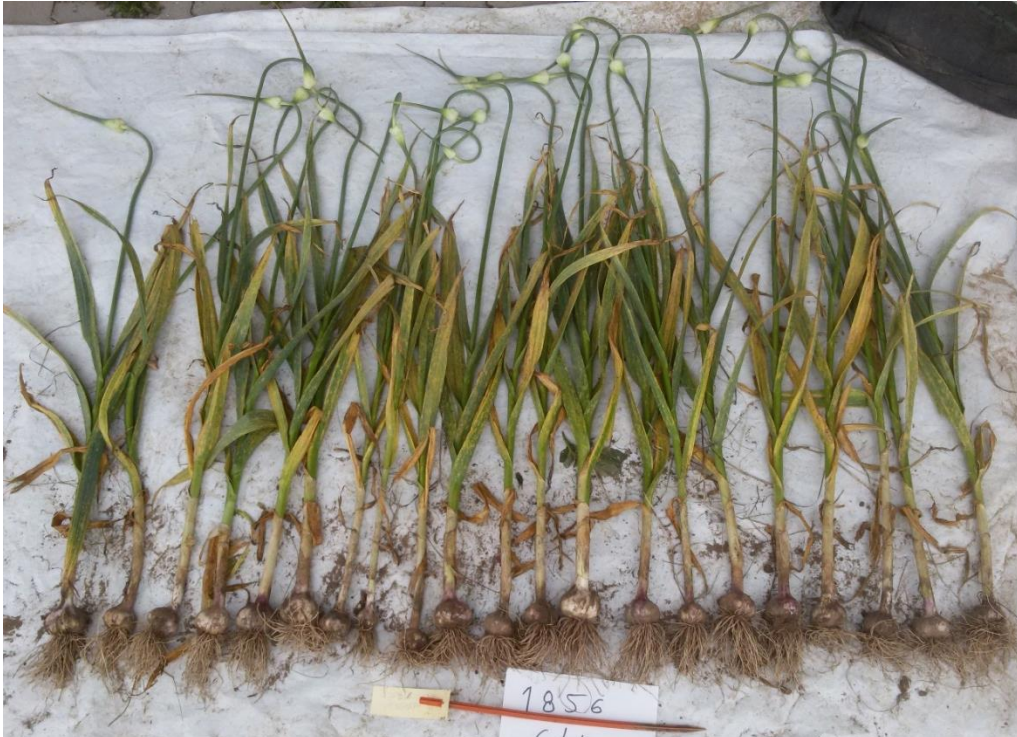


FIGURE 13 VAR. 1856 WITH MULCHING



FIGURE 14 VAR. 1856 WITHOUT MULCHING

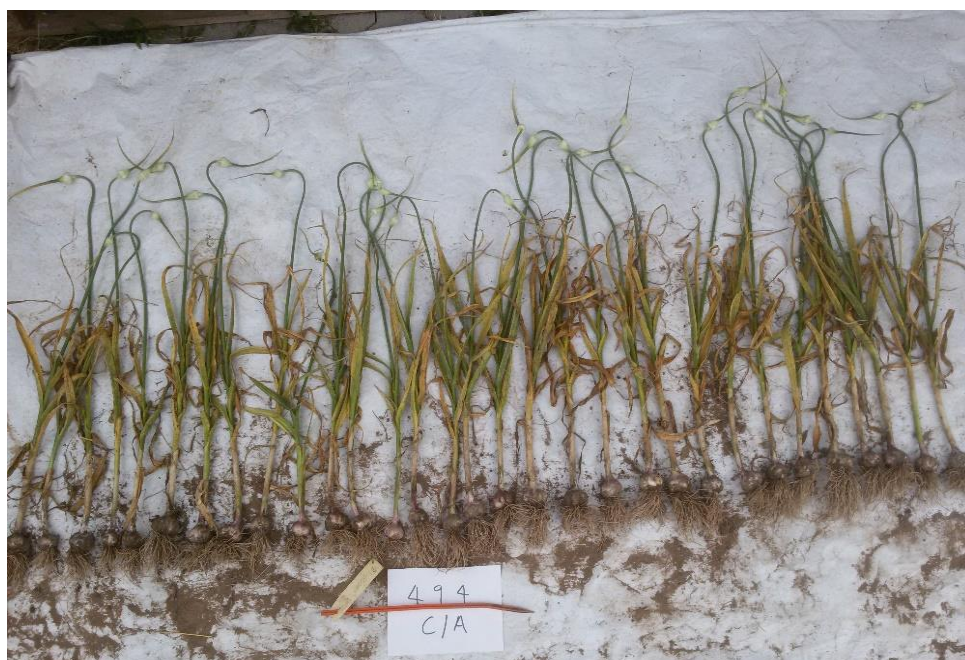


FIGURE 15 494 WITH MULCHING

As mentioned before, var. 494 presents similar biomass in the two treatments.



FIGURE 16 VAR. 493 WITHOUT MULCHING

4.4 Results of the growth variables: height, number of leaves and potential photosynthetic surface.

As shown in the graph below, height is a growth variable that increases over time in almost all varieties and treatments. It is higher in the mulched varieties except for 494, where the difference is not as marked.

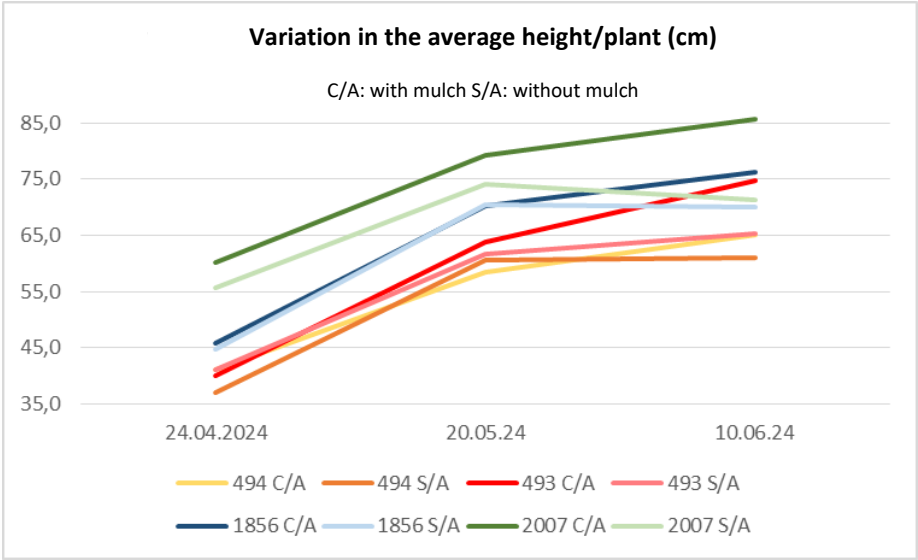


FIGURE 17 VARIATION IN HEIGHT IN VARIETIES WITH AND WITHOUT MULCH, MEASURED ON THREE DATES

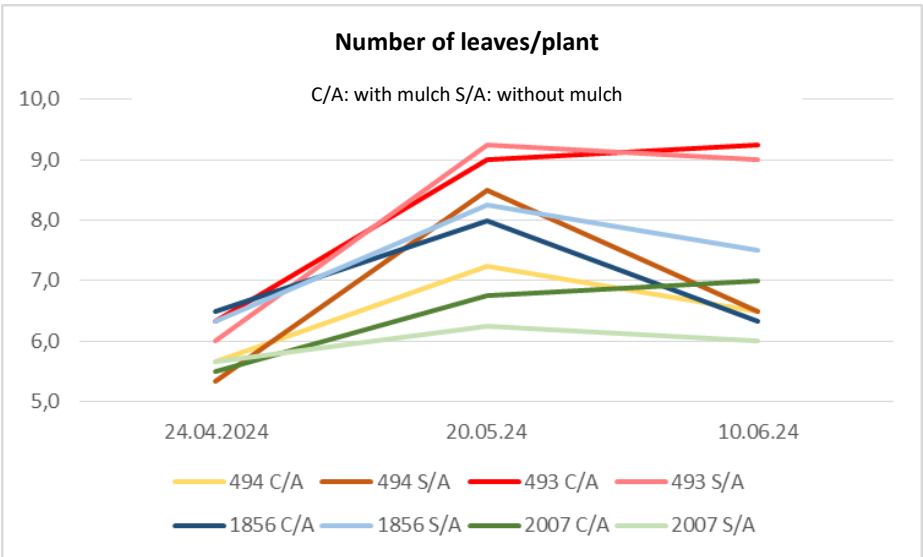


FIGURE 18 VARIATION IN THE AVERAGE NUMBER OF LEAVES PER PLANT IN VARIETIES WITH AND WITHOUT MULCH, MEASURED ON THREE DATES

The number of leaves increases throughout the growth cycle from spring until before harvest, and in general is almost the same in both treatments but in v494. As

harvest approaches, the leaves turn yellow from bottom to top and die. This is probably why they are no longer counted and the number of leaves decreases.

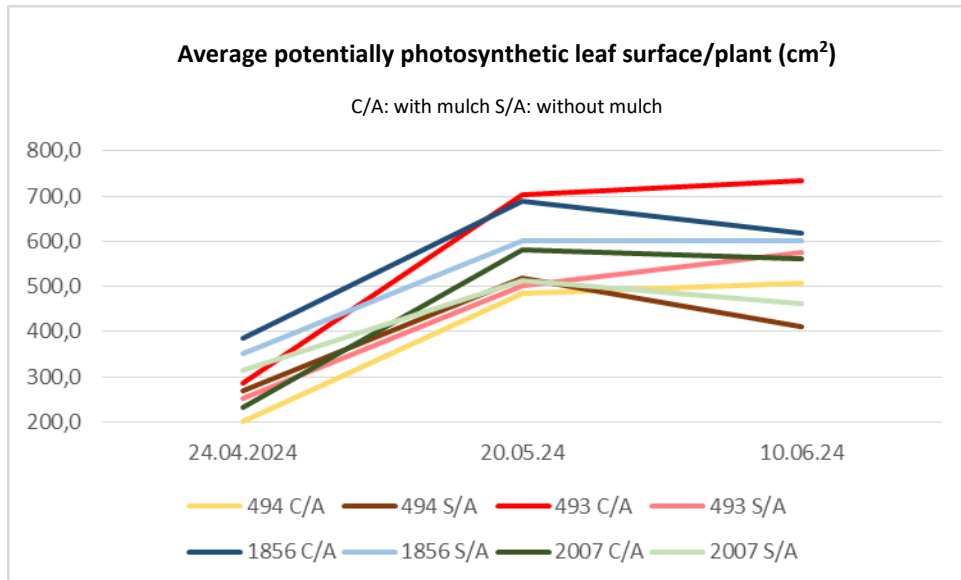


FIGURE 19 VARIATION IN THE AVERAGE POTENTIALLY PHOTOSYNTHETIC LEAF SURFACE PER PLANT IN VARIETIES WITH AND WITHOUT MULCHING MEASURED ON THREE DATES

For this growth variable, the surface from above and below the leaves of the entire plant are being considered. In all varieties there is a large contrast between the curves indicating the treatment with mulch and without mulch, except in var. 494, whose curves look similar. Here also the surface is equal or smaller when the leaves turn yellow.

5. Discussion

5.1 Development of garlic varieties under mulched and unmulched conditions.

Regarding qualitative variables such as colour, in an observation made on 20 March, I saw that the plants under mulch for all varieties in general were darker green than the varieties without mulch. However, I was struck by the contrast of light green and slightly yellowish colours in the varieties without mulch.

In some varieties the leaves have a looser, drooping habit (var. 494 and 494) and others have a more erect habit (2007 and 1856) in both treatments, that is, both in soil with mulch and soil without mulch.

Also, soil with mulch generally presents less fluctuations in temperature due to the insulation effect of the soil (data not represented in this text), which favours the

growth of the entire plant, that is, increases its biomass. This can be observed in the bar graphs both in the fresh weight, as well as in the dry weight in var. 493, var. 2007 and var.1856. However, in var. 494 it is observed that in general the biomass is lower in the mulch treatment or equal in both. It was also observed that mulching reduced the growth of weeds on the soil surface.

5.2 Goetheanism and the ability to observe

After capturing the observations made in the field and writing them down, and reflecting on them, I understood even more that visiting the field is very important, which I did not do as I should have.

It was confusing for me at first, how to collect the observations. I realized that I was drawing conclusions that were not part of the phenomenology. Specifically, in the first observations, I tried to describe the “size”, but then I asked myself, what is size, what does it refer to? Does it refer to the width or length of the leaf, or the height of the plant? All this was not clear to me.

So from 25/04/2024, when I was going to make field observations, I began to corroborate them with the measurements that I had begun to take that week of the growth variables: plant height, number of leaves, width and length of leaves per plant, which was recommended to me. An important aspect for me is to highlight that the guidance of a tutor who accompanies and knows the subject and the processes is necessary, when faced with an unknown phenomenon.

Another example of gaining clarity from this method was learning to wait and not to get ahead of myself. For example, I thought that taller varieties would have a higher bulb yield. However, when I harvested, I found that this was not the case. Instead, mulched varieties, which are generally shorter, have a higher yield than varieties without mulch.

Returning to what Goethe proposed in the Phenomenology, where he describes the aspects perceptible by the senses and conceptual aspects, based on field observations made for the different varieties, that is, assimilated by the senses, there is a conceptual correspondence with the quantitative data collected in the tables, which brings me closer to the essence of garlic cultivation in this case.

Regarding the perception of the invisible raised by Steiner, I wonder what is invisible? Is it perceiving the etheric or astral aspect? Throughout the cultivation, I realized that it was difficult for me to understand what he was referring to, perhaps I should repeat the cultivation several times, I don't know. But I did understand that it is important not to miss opportunities to follow the cultivation in all its stages.

What does it mean that the observed phenomenon is the explanation itself? For example, if I had two photos of the same variety with and without mulch, as in the case of var. 494, without knowing it or its cultivation history, and I asked someone: is it the same variety? The answer would be yes, it is the same variety cultivated with the same treatment. However, I know that both batches of plants have been cultivated under different treatments, but the photograph shows in this case that the rule that under mulch, it presents greater biomass was not followed. In other

words, the phenomenon (the plant and its expression in the photos) prove it to me, since they look the same.

Another question I asked myself was: What does garlic mean to me? This question kept coming up during this experiment. A possible explanation for this phrase could be, for example, going to the field and, for a certain crop, recognizing the variety, even without observing the crop, mentally visualizing the crop and the variety and its possible forms in different environmental conditions (heat, cold, shade, sun, etc.), management (drip or sprinkler irrigation, fertilization, use of mulch or not), etc. Precisely in the case of garlic, this occurs more markedly (already studied by many researchers before).

In Phenomenology, we speak of the phenomenon (experiment) and that it mediates between the object and the observer. That is, I was also part of the experiment. I was able to corroborate this by becoming aware that it was the first time I had cultivated a crop from beginning to end in its entire cycle. This made me think that although I had visited many farms, I really had little experience in understanding the essence or idea of crop management. In conclusion, I learned about my own essence, my qualities to improve or develop in myself first in order to successfully manage a crop.

6. Conclusion

The results were revealing for this experiment, but it is important not to take them as definitive; the experiment should be carried out at least two more times, as recommended. Since a greater biomass and development of the bulb under mulch was seen in three of four varieties.

To continue developing the Phenomenology in myself, I should continue planting and gain experience in managing garlic cultivation.

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