POSEIDON - a tool to support the orientation towards a sustainable improvement of organic fruit growing in participative working groups

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Abstract

In the frame of the project "network for improvement of the production system in organic fruit growing" (BOELN-project Nr. 04OE178/06OE100) a group of fruitgrowers, consultants and researchers from all German regions started to discuss approaches to improve the orientation of their production system towards the principles of organic farming (POA). Several working groups on different topics have been generated in this network. In a participative process involving fruit growers, researchers and consultants, POSEIDON, a first indicator system has been developed to support the decision making process of these working groups by presenting relevant data from practice and analysis. In the BOELN-project 2810OE024, a field record system and a benchmarking system to collect and present the parameters based on these indicators necessary for the working group "reduction of copper and of general input of plant protection products" are prepared and evaluated.

POSEIDON aims to support the discussions about different strategies with data presentation. POSEIDON does not aim to replace the discussion about the best strategies to improve the orientation towards the POA by a rating system for "best practice" referring to the actual state of scientific knowledge. The nucleus for the improvement of the production system is not the model but the working groups consisting of growers, consultants and scientists.

Keywords: system approach, sustainability, indicator system, organic fruit growing

Introduction

Since 2004, in the frame of the project "network for improvement of the production system in organic fruit growing" (BOELN-project Nr. 04OE178/06OE100) a group of fruitgrowers, consultants and researchers from all German regions discuss possibilities to improve their production system (Kienzle *et al*., 2008, 2010). In the last years a necessity was felt to proceed in a system approach and in a concerted action to ensure a sustainable further development.

Furthermore, discussions with authorities required to picture the production system of organic fruitgrowing, especially regarding aspects of plant protection. In consequence, a working system that allows to improve organic fruit growing supported by on farm data should be developed.

Material and Methods

The system was developed in a participative process involving fruit growers, researchers and consultants. At the end of 2007, in the frame of the BOELN-project-Nr. OE06100 "network for improvement of the production system in organic fruit growing", a working group "POSEIDON" was founded. This group had the task, to work out first drafts for a system that should allow to structure an aim-oriented purposeful sustainable further development of the production methods. The system should also be suitable to explain the

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production system and the trends set in further development, especially in the plant protection system, to persons and authorities outside the organic sector.

The practicability of this system was evaluated in discussions about several topics, mainly regarding the areas plant protection and biodiversity:

- Reduction of the amount of copper used
- Strategies for resistance management, especially for codling moth
- Pro and Contra of the use of Spinosad in codling moth control
- Integration of aims of nature conservation in the cultivation methods

In the last years the subject of copper reduction was discussed very intensively in Germany in the organic sector and also with authorities. Thus, this topic was chosen for the first evaluation of the system in several working groups consisting of fruit growers, consultants, researchers and representatives of organic associations.

Since most topics regarded plant protection, in a first step the presentation of data about the plant protection practice in common models for sustainable agriculture was examined.

In most farm management systems as e.g. REPRO, an ‘application-index’ is used to summarize the data of the plant protection practice (Heyer *et al.,* 2005; von Haaren *et al.*, 2008). The working group decided, that this kind of presentation was not suitable as a data basis for a sustainable aim-oriented development of organic fruitgrowing since most relevant data (kind of products used and their side effects, toxicity and persistence) about the products applied were not considered and other measurements than the application of plant protection products were not included at all.

Thus, a specific concept for presentation of data relevant for the plant protection system suitable for organic farming was developed. The first concept was presented in a first workshop in June 2009. After the discussion it was revised and finally discussed in the annual meeting of the “network for improvement of the production system in organic fruit growing” in December 2009. The data requirements and the calculation and presentation of the single parameters were worked out in smaller working groups consisting of 4-6 fruitgrowers and one or two consultants and/or researchers. During this activity the idea arose to use this system also as an instrument for the extension service. A draft for a benchmarking system related to the system used by the Bioland Beratung GmbH in quality management systems (Boehm *et al.*, 2011) was evaluated in small working groups of 4-5 fruitgrowers and one consultant in several German fruit growing regions (Lake Constance, Neckar valley and Baden, Rhineland Palatinate, Northern Germany, Saxony).

The issue of these working groups was that there was great interest to have a benchmarking system based on this first draft. In consequence of this discussion, a project (2810OE024) was started at the end of 2010. In this project, software to record and evaluation of the data and for benchmarking the parameters is developed. Working groups consisting of 4-6 growers and one consultant in each of the four regions involved actually are evaluating and improving the software. Furthermore, in 2011, methods for a fast and practicable estimation of the success of the strategies (level of infestation with several pests and diseases) are elaborated and evaluated by the group.

Results

1. Targeting and sustainability concept

In the participative workshops with fruit growers, a “theoretical” discussion about the different concepts of sustainability used in Germany (Brand & Jochum, 2000) was not practicable. The first definition of sustainability was based on Meadows (Meadows *et al.*, 2006) “a development is not sustainable if it erodes its own basis and for this reason will not endure". In the model of the "three pillars" used in Germany (Brand & Jochum, 2000) this is a classical base of economic sustainability. In the discussion it became obvious that the basis of organic farming are the principles of organic farming (POA) as formulated by ifoam (www.ifoam.org). Since the POA are the basis for the "society pact" for higher price for products from organic farming, for organic farmers there is a crucial difference to conventional farming regarding economic sustainability: For organic farming, which aims explicitly in a holistic approach to enhance the stability and biodiversity of the agroecosystems as well as the fertility of the soil, it is economically crucial to consider this in the further development of the production methods.

Thus, since the POA cover the important fields of sustainability, the POA were just adapted as "sustainability concept" for the orientation of the further development of the production method. A better orientation to the POA was set as the "major aim" of all further development. If particular targets are followed, as for instance the reduction of the amount of copper used, care must be taken to consider all aspects of the development and to evaluate also an eventual cost of the success in other areas by reaching the particular target. Reaching a particular target must never lead to a decline of the whole production process in its orientations towards the POA. To picture this concept, the terms "aims", "bricks" (to achieve the aim) and "guardrails" (to point out the cost of success") were introduced.

2. Indicators

Indicators are used for the measurement of certain parameters. In most systems, indicators derive from several parameters that are summarized and weighted following specific criteria. Qualitative parameters are transformed into numeric parameters to make possible a general summarizing of all parameters. The issues of some analysis are "sustainability rates" derived from weighted and summarized parameters (Kuestermann *et al.*, 2002). The growers refused forcefully this kind of presentation and rating. During the discussion about the parameters and the data to collect they realized that with a justifiable effort it seemed not realistic to determine the whole production system in a way that a really holistic rating considering all aspects would be possible.

Their arguments reflected also the principle of care which advises to consider that there is an incomplete understanding of ecosystems and agriculture and that "scientific knowledge alone is not sufficient but must be backed by practical experience as well as by traditional and indigenous knowledge". Furthermore, in organic fruit growing there is still a rather fast development of knowledge and the "state of scientific knowledge" in organic fruitgrowing is a rather variable factor during time. Thus, the weighting and summarizing of the parameters into indicators for a evaluation of "good practice" and "bad practice" seemed not reasonable as base for the orientation of further development. Instead of using the rating by a model for orientation, the growers demanded a discussion process according to the common practice in the "Working net" but based on real data from practice. The single parameters should be presented individually. The process of rating and weighting should be part of the discussion where growers, consultants, scientists and members of associations should be involved. The competence for orientation of the further development was clearly seen in this discussion process. What was required was a presentation of real data as support for the decision in a discussion process. Since it is impossible to present really all data for the whole production system, the level of detail and the number of parameters for the data presentation is the key factor that has to be decided. Actually, several particular targets for the development have been roughly defined by the group just discussing about a better orientation towards the POA. Thus, it is possible to decide according to the particular target about the level of detail and the kind of parameters to present as a base for the discussion process for further development. The group demanded to have a detail level in presentation of the main parameters regarding the relative strategies that allows a structured discussion. The main parameters regarding a possible success, a possible cost of success and the “bricks” for possible strategies must be presented individually. Thus, the level of detail of the presentation depends also on the strategies discussed. If, for instance, it is discussed to replace a treatment with a high amount of copper by a treatment with potassiumhydrogencarbonate, there is no need to specify the risk for aquatic organisms with any model since the situation is evident. However, if very low amounts of copper are replaced by high amounts of sulphur, it is maybe difficult to estimate just by evidence the impact of the two different strategies on aquatic organisms. In such a case, if available, a simulation model like SYNOPS (Gutsche & Strassemeyer, 2007) is needed to calculate the theorical impact of the two strategies on certain key species. If simulation models are used, the growers demanded that the path of calculation must be revealed. If different risks must be considered and appropriate models are not available, the risk must be presented in an acceptable mode in spite of the lack of a model. For the possible long term effects of low amounts of copper on soil organisms, for instance, it is actually difficult to find an appropriate model. Certainly, it is not possible just to neglect a preventive minimization of this possible risk. The parameter for presentation used in this case is simply the amount of copper in kg used per unit of area (ha) and year – just according to common practice in the guidelines for organic production for many years. Generally, the fruit growers exercised the system approach not only in the evaluation of their production methods but also in the evaluation of potential risks of plant protection products. The first criterion to evaluate the potential risk of a product was the occurrence in the system. The risk of a product was the more questioned the more external of the production system it occurred in nature. Ultimately, the restriction to natural substances in organic farming can be explained by this system approach in risk reduction.

In Table 1, as an example, the set of parameters for the target “reduction of the amount of copper” is described. For targets regarding the plant protection system, parameters are grouped in three pillars:

- Input of products and energy
- Sustainable farm management
- Functional biodiversity

For the presentation of several parameters, the data from the farm units can be computed in models that can provide further informations. For the estimation of the potential risk for aquatic organisms, for instance, an interface to SYNOPS designed by the institute for risk assessment of the JKI (Gutsche & Strassemeyer, 2007) is projected.

The particular *potential of a single active ingredient for resistance building* of the substances, if relevant, is expressed in a first approach based on the existing experience sorting the substances in 5 classes:

- Class 1: Applied since more than 50 years on large areas, no resistance observed. Unspecific mode of action (e.g. sulphur, copper)
- Class 2: Applied since more than 20 years on large areas, no resistance observed. Unspecific mode of action or more than one active ingredient
- Class 3: Applied since less than 20 years on large areas, no resistance observed. Unspecific mode of action and/or more than one active ingredient. The risk of resistance building in literature is estimated low but not excluded.

- Class 4: Applied since less than 20 years on large areas, no resistance observed. Only one or two rather purified active ingredients. The risk of resistance building in literature is estimated higher or similar products have shown resistance or for this product resistance building was observed on pests or diseases on other crops.
- Class 5: Cases of resistance observed with active ingredients with similar mode of action.

Table 1: Parameters for the presentation regarding the target "reduction of the amount of copper applied" grouped in the three pillars of the plant protection system. For parameters with *) details are explained in the text

<table>
<tr><th>Input of plant protection products and energy</th><th>Sustainable farm management</th><th>Functional biodiversity</th></tr>
<tr><td rowspan="3">Active ingredients and quantity applied.
If this is not sufficient for decision-making:
- Parameters for the potential risk for human health and environment *)
- Parameters for the risk for resistance building against the active ingredient *)
- Parameters regarding a life cicle analysis of the active ingredients</td><td>Sustainable application
- Use of forecasting models
- Application technique
- Formulation</td><td rowspan="2">Genetic biodiversity
- Genetic biodiversity of the varieties *)
- Genetic diversity of variety resistance</td></tr>
<tr><td>Cultivation methods
- Reduction of the inoculum
- Enhancement of the fertility of the soil
- Balanced fertilization
- Balanced tree growth and crop load regulation measures</td></tr>
<tr><td>Choice of Variety
- Percentage of scab-resistant varieties
- Percentage of varieties with low susceptibility to scab or (in special regions) canker</td><td rowspan="4">Species diversity
- Protection*) and enhancement of beneficial organisms</td></tr>
<tr><td rowspan="3">Number of applications necessary
If this is not sufficient for decision-making
Energy consumption for the applications</td><td>Alternate application of active ingredients if necessary regarding the risk of resistance building</td></tr>
<tr><td>Organization of the farm unit
- Number of application equipments in correlation to the area of scab susceptible varieties</td></tr>
<tr><td>Economic success of the farm unit
- Yield and quality *)
- Cost of the strategy
- Risk of losses *)
- Marketing success</td></tr>
<tr><td></td><td>Local and seasonal factors
- Seasonal infection pressure
- Local attitude for infections</td><td></td></tr>
</table>

The general *genetic biodiversity* is expressed using the data based partly on the data collected by Bannier (2011). An index based on the conformity of the genetic heritage based on the genealogy of the varieties is actually tested. For the strategy of copper reduction this index must be completed by guardrails regarding the sensitivity of the different varieties against different races of scab as the disease of main importance. These data are not yet available but should be collected.

The *side effects of plant protection products on beneficials* will be shown using a decision-making support model in preparation by Kienzle & Zebitz. At first, beneficials are classified as system relevant (efficacy to suppress the relative pest without other control mechanisms is documented), relevant (important effect on pest is documented) and less relevant. As data base for the side effects of the products mainly classifications related to the IOBC classification and available on the registration sheet of the products and other publications are used. However, in the interpretation of the data it must be taken into account that the basic data are not always comparable (laboratory and field data). The presence of stages of the insects sensitive to the products is indicated using data sheets where their occurrence is listed in relation to the BBCH-Code. The mobility of the insects is taken into account using a class system regarding their mobility over longer distances and their possibility to immigrate from landscape elements as hedges in the orchard.

In the context of plant protection strategies the most important parameter for the *quality of the fruits* is the percentage of infested fruit by a certain pest or disease. It is not practicable for the fruit growers to assess the infestation in their orchards with methods similar to researchers. However, it seems practicable for them to monitor the infestation levels of their fruits using a class-divided system. In 2011, a first schedule for 5 classes for scab and sooty blotch infestation was tested in the working groups. The survey of the infestation level is also used for the discussion about regional thresholds for the application of different strategies, e.g. for scab control.

It is important to remember that especially for the evaluation of plant protection strategies it is important to have long term data from different farm units in different regions. Failing this, a reliable estimation of the *risk of losses* and, thereby, of the real economic efficiency of the strategy is impossible. The risk of losses is expressed by the probability of losses (number of years with losses assessing a certain number of years and a certain number of farm units).

3. Data collection

For the collection of the data in the field a field record system is used. Basic unit is always the farm unit. For the fruit growers, it is very important, that data has to be recorded only one time. Thus, the field record system must be suitable also for the recording of the data relevant for audits, e.g. Global GAP or the controls of the associations and for the requirements of the agricultural administration. Actually, one field record system is adapted to these general requirements of the organic fruitgrowers and simultaneously for those of the data collection for the benchmarking system of POSEIDON. The parameters are preset so that benchmarking is possible. Generally, the data collected should not exceed substantially the data that the fruitgrowers collect for their other necessities.

4. Benchmarking system

The different strategies are presented by a list of the parameters relevant for the strategy. The data regard the level of farm unit, plot and single variety. New strategies are defined looking at the differences to a “standard strategy”. This standard strategy is defined usually as the mean values for the relevant parameters of the participating farm units from a defined area (e.g. one region). If necessary, the pool of farm units can be specified even more about several selection criteria. The data of the single farm unit remain anonymous. Each fruit grower is able to view his own data and the mean of the group. Thus, a kind of self evaluation is possible.

Since plant protection strategies usually are described using a large amount of parameters, it could be difficult to have a clearly arranged presentation of the data.

Thus, parameters with values different to the standard strategy (the criteria for discrimination can be defined by the user) are marked and listed first. Even if the list of parameters to describe the strategies is long, in fact the user is working on the few parameters that show relevant differences. However, if a new strategy shows a difference to the standard strategy in some new parameter, this is not neglected since all relevant parameters are always listed and can be marked.

5. Presentation of the working groups

In the German "Working net" there are different working groups with main focus on variety and rootstock testing, reduction of the input (especially copper) or the enhancement of biodiversity in the orchard. These groups will present their work on the Foeko homepage. The presentation of the activities to improve the orientation towards the POA was discussed also intensively in the working net. It was considered very important for this aim that the presentation of the working groups is transparent and faithful, scientifically sound and fair. The presentation should not downgrade other farmers or farming systems and should contain in the medium term concrete targets the working group wants to achieve. It should show the progress but also eventual measures to evitate a cost of this progress. In this context, even if special targets are followed, always the whole production system must be considered.

Furthermore, working groups should share their experience with the other organic farmers, and, in this way, contribute to a sustainable advancement of the whole sector.

Discussion

The participative development in an interactive discussion process produced a working system very near to the origins of organic fruitgrowing. At the beginning, the production method was developed in small regional working groups of fruitgrowers. Base of the development were the principles of organic farming. In a second step, consultants and researchers joined the group and integrated scientific knowledge.

POSEIDON gives the possibility to reproduce this kind of work on a larger scale. The existing data from many farm units can be presented anonymously and structured. If necessary, smaller calculations or models can be integrated to evaluate certain parameters. The development of the system can follow the needs of the main topic and of the working group. In this way, POSEIDON can support the discussions about different strategies with data presentation. POSEIDON does not aim to replace the discussion about the best strategies to improve the orientation towards the POA by a rating system for "best practice" referring to the actual state of scientific knowledge. Since it is never possible to consider really all parameters of a system a really holistic picture of the production system seems not realistic. Thus, a rating based on a certain indicator set could easily set trends that do not really lead to an improvement of the orientation of the production system towards the POA but, in contrary, can compromise the holistic system approach of organic farming.

The nucleus for the improvement of the production system is not the rating by the indicator system but the working groups consisting of growers, consultants and scientists. The benchmarking system does not aim to increase the competition between the fruit growers. It aims to enhance their collaboration in a collective improvement of their production system – always learning from each other.

In the next years, POSEIDON will be evaluated as a tool for the presentation of real data and as a support for decision making with the aim to improve the efficiency of these working groups. It will be also tested by extension service as a tool to record and to structure the experience of a large number of fruit growers over the years.

Several years experience will show how the system can be used best and several years will be needed to adapt the first version to the needs of different working groups and regions.

Actually, a first software based version is evaluated in the working group “copper reduction” by 20 fruit growers in four regions in collaboration with the respective extension service.

If POSEIDON succeeds to connect data regarding the state of scientific knowledge and the practical long term experience and, thus, to combine knowledge with experience, it will be a valuable instrument for participative working groups to collaborate successfully in improving the orientation of organic fruit growing towards the POA.

References

Bannier, H.J. (2011): Moderne Apfelzüchtung: Genetische Verarmung und Tendenzen zur Inzucht. Erwerbs-Obstbau (3):. 1-26.

Boehm, H.; Buchecker, K.; Dresow, J.; Dreyer, W.; Landzettel, C.; Mahnke-Plesker, S. & Westhues, F. (2011): Optimierung der ökologischen Kartoffelproduktion. [Improvement of organic potatoe production.] Landbauforschung, Nr. Sonderheft 348. Johann Heinrich von Thünen-Institut, D-Braunschweig.

Brand, K.W. & Jochum, G. (2000): *Der deutsche Diskurs zu nachhaltiger Entwicklung.* Abschlussbericht eines DFG-Projekts zum Thema *Sustainable Development/Nachhaltige Entwicklung – Zur sozialen Konstruktion globaler Handlungskonzepte im Umweltdiskurs.* Münchner Projektgruppe für Sozialforschung e.V., MPS-Text 1/2000.

Gutsche V; Strassemeyer J. (2007): SYNOPS - ein Modell zur Bewertung des Umwelt-Risikopotentials von chemischen Pflanzenschutzmitteln. SYNOPS - a model to assess the environmental risk potential of pesticides, Nachrichtenblatt des Deutschen Pflanzenschutzdienstes Band: 59, Heft: 9, Seite(n): 197-210

Heyer, W.; Roßberg, D.; Abraham, J. & Christen, O. (2005): Erfassung und Beurteilung der Intensität des betrieblichen Pflanzenschutzes innerhalb des REPRO-Konzeptes. Nachrichtenbl. Deut. Pflanzenschutzd., 57 (6): 126–131.

Kienzle, J.; Haug, P.; Ortlieb, R. (2010): Towards more sustainability in organic fruit growing: German fruitgrowers first steps to improve their production system. Proceedings Ecofruit 2010: 391-394.

Kienzle, J. (2008): Fruitgrowers towards a new approach to enhance biodiversity in organic orchards. Proceedings Ecofruit 2008: 339-343.

Meadows, D.; Randers,J.; Meadows, D. (2006): Grenzen des Wachstums. DAS 30-JAHRE-UPDATE Signal zum Kurswechsel aus dem Englischen von A. Held S. Hirzel Verlag, Stuttgart 2006: 323 p.

Küstermann, B.; Abraham, J.; Hülsbergen, K.-J.; Nehring, W. & Christen, O. (2002): Praxiseinführung des Modells REPRO zur Bewertung der Nachhaltigkeit landwirtschaftlicher Betriebssysteme. 114. VDLUFA-Kongress vom 16. bis 20.9.2002 in Leipzig

Von Haaren, C.; Hülsbergen, K.J.; Hachmann, R. (2008): Naturschutz im landwirtschaftlichen Betriebsmanagement. Ibidem-Verlag, 2008: 267 p.