Doing without pesticides: a challenge and an opportunity not just for agriculture

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In a pesticide-free future, conventional agriculture will have to learn what has long been practice in organic agriculture. For over 35 years Peter Kunz Cereal Breeding, Feldbach ZH, has developed varieties for organic agriculture that do very well without pesticides. For this reason, they have for years been a benchmark for organic quality wheat in both Switzerland and south Germany. What is this fundamentally different approach, and what are the challenges facing agriculture and breeding when it dispenses with synthetic pesticides?

Healthy agriculture forms a whole with the environment, embedded in an ecosystem, and at the same time enriching it. Thus it can sustain itself in the long term, and with good management can produce sufficient yields to nourish the part of the population not engaged in farming. Pests and diseases, often conventionally combated with pesticides, are a part of this ecosystem. However, they are not the causes but merely the symptoms, the indicators of underlying disease. Their appearance shows imbalance in the system or in its physiology whose one-sidedness the crops can counterbalance in no other way than with a disease or a pest attack. Such imbalance is triggered for example through the demand for absolutely flawless products. In the marketplace the universal wish for blemish-free apples and potatoes is a symptom of the lack of understanding for and awareness of the real life contexts providing our foods.

Furthermore, constitutionally weakened and therefore susceptible crops are frequently the result of intensive management and fertiliser use as well as of one-sided breeding. This is an inescapable circle unless we can understand the whole as a living organism (or as a system). This is the really big challenge in science as well as in practice. Agriculture should not be regarded abstractly in the sense of industrial input-output production. Single cause thinking based on mechanical-technical solutions always leads to symptomatic alteration of individual desired or undesirable elements. But in a living system this always has undesirable consequences and unexpected side effects. In a living ecosystem, the first measure taken from monocausal-mechanical thinking inevitably has its effects and so too do subsequent measures. The end result is always at the expense of the stability of the whole organism.

In contrast, if we start with a fundamental conception of a healthy farm, with the crop plant itself or with the whole organism of a regional landscape, the significance for the whole and the contribution of its individual elements can be more easily understood and managed. This way, agriculture's mission becomes that of comprehensively shaping the resources of an initially self-sufficient organism. No longer would more animals be kept than the available feed supports each year. There would be no nutrient surpluses and the groundwater problem, due to manure and slurry, would not arise. This is not a return to old self-sufficiency farming, for the more able is a individual farm organism – or a region – to supply itself through its own resources, the more productive will it be as a whole, and thus able to generate large surpluses.

Recognising and understanding living organisms – a challenge to science

Science always presupposes the living organism. Since Kant, the problem of conceiving a living whole has been externalised into the realm of belief and religion. It is the same kind of thinking that tempts industrial concerns to pass on their environmental and societal costs to others. A scientific thinking that always seeks to be objective, externalises itself and does not really want to face the challenge of the problem of understanding life. In mechanistic-reductionist thinking, the symptoms of life are studied superficially from the outside, but scientists do not get at its real causes and roots. The living always arises from the living – the continuity of life cannot be broken. Even manipulating DNA base sequences with modern molecular biological techniques always presupposes this fact, yet always conceals it in the presentation of results. Its effects on the overall whole are justifiably sensed as risky and adventurous, because this approach lacks real understanding of the living organism itself. In order to gain a new, real, responsible relation to ourselves and to our environment, it's time to say goodbye to the idea that the observer is external and always independent.

Working with the living whole – the challenge for practice

Organic agriculture and organic breeding also presuppose life and a pre-existing ecosystem. They work within this living system, but from the outset give the whole a different priority. Farmers and breeders are aware that they participate in the entire context and integrate all partial elements that are currently knowable. And they too have so

much more to learn! Thus biodynamic and organic farming are still far from offering the best solutions in all areas, but their practitioners are heading in the right direction. There are too many positive examples world-wide to simply ignore this.

The example of organic breeding may help clarify the procedure. From the outset the whole course of breeding takes place in real organic cultivation conditions on holdings that are consistently worked organically. There are no short cuts, for example via a laboratory, because the interrelationships, the subtle interactions of the plants with their environment, are the source of their growth, their health and the development of their quality and should therefore not be disturbed. The aim is not for high yielding varieties with maximal individual results, but for a constant improvement of the overall yield of the living ecosystem, for example the crop rotation of a farm at a very specific location. The breeder must engage with all this, because he deliberately seeks those varieties that best realise the overall potential of a location as a whole.

Future varieties should engage with the given conditions in a healthy way and give reliable results over a long period. Increasing seasonal extremes, as in recent years due to climate change, show that from now on the stability of growth and the development of yield and quality of varieties under stress conditions should be assigned significantly higher priority. Specifically, the crop, in the various places it is grown, should provide three harvests that have to be balanced against each other. The first serves to nourish the life of the soil, i.e. the soil organism, through root growth. The second provides the nourishment for the farm organism with fodder, straw and other organic material for the animals, the crop rotation and the organic manure management. And only the third is the production of healthy fruit and foods in sufficient amounts and quality. The first and second harvests represent the health and sustainability basis for the third. If the first two are ignored, not only would the stability of the yield and quality suffer, but also the whole operation would sooner or later be damaged, i.e. fertility and resilience would decline. Because each crop has its one-sidedness, in a healthy farm this should be compensated for through crop and fertilisation measures and through the crop rotation sequence. For example, in intensive cereal monocultures, straw, a crop residue, is regarded as an encumbrance because among other things it can encourage pathogenic fungi and reduce nitrogen availability. The result of this is that short-straw varieties from modern breeding are preferred. If there is no other use for the small amount of straw that still remains in the fields, in many places it is burnt, in the best case to produce energy, though frequently just in the fields. By contrast, straw is used in organic farming as bedding or fodder and, in the right mixture with animal dung, provides an ideal organic fertiliser which not only enables control of the nutrient cycle of the farm organism but also significantly contributes to long-term improvement of soil fertility and sequestration of CO_2 or carbon in the soil. Several tonnes of CO_2 can be sequestered per hectare. Plants that grow in organically fertilised soil need 20-40% less water and therefore respond more tolerantly to the increasingly common extremes of weather such as drought and heat stress. The robust cereal varieties from organic breeding are significantly longer than those from conventional breeding and therefore produce more biomass and straw. This is the basis for their proven high yield and quality stability, because combining organic fertilisation to increase soil fertility with the appropriate variety types reciprocally improve each other and the entire system.

What benefits can be gained from this approach?

- Enrichment and diversification of the work of practice and research

For both agricultural practice and science, the first thing is the enrichment and diversification of the work through a reorientation of outlook and issues raised. Awareness of and promotion of interactions between the elements of the whole increasingly take centre place. An example might clarify this: what kind of growth and crop management promotes the diversity of flowering plants and thereby the beneficial insects over the whole vegetative period? We have long been accustomed to the hay harvest starting in May instead of as formerly in June. Thus we get more protein-rich hay and higher milk yields from the cows. The earlier and more frequent cuts as well as intensive fertiliser application, increase vegetative growth, but this shift in vegetation comes at the cost of both a deeply penetrating soil root system and flowering plants. Thus the habitat and food of many beneficial insects is lost while nutrients seep away into the deeper soil layers where they can no longer be used by plants. How can we compensate for this – with selected varieties and mixed cropping, with temporally staggered use, or with flower strips and hedges in the landscape? It's not necessary to turn back the clock fifty or a hundred years! A variety of solutions are possible.

- Protection, conservation and development of the commons

By comparison with the narrow focus on individual pest or disease organisms, the reorientation of outlook provides an enrichment of approaches as well as greater tolerance of the diversity of other living things. This brings into view the commons which is looked after and developed by agriculture – not least in its own interest – providing a long-term enhancement of soil fertility, clean ground and surface water, rich fauna and flora, clean air as well as an interesting and diverse landscape to live in and for recreation. Agriculture is a challenging landscape development project.

- Unpolluted food – lower health costs?

Whether residues in the groundwater and in foods, and pollution in the environment lead to higher health and other consequential costs is debatable. Fundamentally, the fact is that pesticide residues do not belong in the ecosystem and use of pesticides should be avoided purely on the basis of the precautionary principle unless their economic necessity and value is really significant. In relation to its currently very low monetary added value, agricultural production (1% of GDP) may actually seem totally insignificant. The economy could without difficulty pay significantly more for its food products! However, as the whole population lives on this food production, and is directly dependent on it, agricultural production is nevertheless highly significant. Before healthy foods are bought and consumed, they can be produced only through a functioning agriculture.

What challenges face the breeder, farmer, researcher, politician, trader and consumer?

The first big challenge is that of rethinking. For agriculture, this requires assistance for training, knowledge transfer and consultation as well as a certain stimulus from economic conditions. Rethinking is more complicated in agriculture. It concerns a person's whole way of life which comprises seven times twenty-four hours and is therefore more demanding than in 'nine to five' jobs. And the rethinking can only happen voluntarily, otherwise we would have to institute 'professional bans' (*Berufsverbote*). And it would not work with only a little bit of organic, as in farming politics hitherto.

The second big challenge comes from the necessary partnerships because agriculture cannot solve the problem alone. It is not enough that farmers have to give up pesticides if the downstream businesses of processing and trade – and ultimately consumers – do not go along with it. Here, going along with it means working together to solve the actual problems resulting from the whole agricultural situation, from its long production cycles and from its great dependence on the environment. And therefore it requires long-term commitment from all partners. We cannot demand sustainability from one partner if the others care not a jot about it.

The practical demands vary according to crop type. Some crops could immediately do without pesticides because suitable varieties and know-how for pesticide-free management already exist and are feasible. But other crops create problems which require increased awareness, and this to some extent creates an urgent need for research in order to find better solutions. Examples such as seed-borne diseases in cereals, potato late blight and fungal diseases in grapes show how the use of fungicides, long taken for granted in conventional agriculture, has directly inhibited research on innovations and new procedures. This involves the practical breeding of more vital and less susceptible varieties, as well as the development of improved cultivation methods and crop management systems.

The third big challenge is an economic one. The greater the price pressure on agriculture, the more the above mentioned commons are exploited and detrimentally affected. The increasing global use of pesticides is the direct result of price pressure. It forces farmers to simplify portfolios, to intensify production and to externalise as many costs as possible. If costs are to be internalised again they will have to be paid for from somewhere. The current transfer payments via state direct payments represent an attempt to solve this basic problem from the outside. This too contains the reductionist-mechanistic way of thinking, and likewise calls for a reversal. The economic community will sooner or later have to solve this problem itself! Only then will a real healing take place. Yet how would a rightful pricing system arise that assures all partners an appropriate and fair outcome for their efforts? Today, much more is earned in non-agricultural professions. We need only compare the wages and profits in the upstream and downstream businesses with those in agriculture. There is still a lot of development work to be done by prioritising the common task of agriculture of sustainably supplying the population with food, and of taking care of the landscape of a region, and placing it at the centre and above the profits of an individual company! That is still unthinkable for many entrepreneurs, but here too the change must begin in the mind. Ultimately everyone knows

that an enterprise goes well in the long-term only if its environment and partners also have good outcomes. The dependency is reciprocal, only this is not admitted in everyday business.

Finally consumers too face an economic challenge. People who always buy the cheapest product need to realise that others must pay for it for them. Somewhere in the world the money assumed to be saved will be at the expense of someone who has contributed to the making of the product. These circumstances are real, only they are concealed through trade. The marked price is a lie, and reaching for the cheapest product works socio-economically like pesticide use does in agriculture! Thus cheap products suppress fairness in trade and inhibit the creation of sustainable production because each purchase directly requires producers and traders to go on in the same way as before. This brings us back to our theme at the beginning of this section. The reversal of the pricing issue here means: am I paying enough so that all the people connected with the product can live and work in the way that I wish for myself? This is how I can overcome my attitude of sacrifice and, as a consumer, become the responsible co-creator of my social and natural environment. Even if the immediate effect perhaps seems outwardly small, this inner attitude and decisiveness creates a potential for innovation and development. Freedom and dignity grow from this source! Nobody need wait for others; it can start now and feels good!

What factors would be the most important for establishing 100% organic seed within ten years?

It requires a consistent orientation and intensification of official variety testing in pesticide-free agriculture. Variety access to markets and seed production is controlled by state registration testing. The present approval rules are mainly orientated to conventional management with mineral fertilisers and pesticide use, and also still contain unnecessary elements of market control arising from national security concerns and from the cold war.

A further important role of the state is the assurance of unhindered access to all genetic resources as starting material for breeding future generations of varieties. Both free market access and access to the resources are parts of the commons to be protected by the state. For example, the patenting of plants represents a hindrance to access and it therefore goes against the democratic principle of equality.

Pesticide-free agriculture needs a greater diversity of reliable varieties. Even the diversity of varieties is a cultural and public good. With each new variety, breeding makes a contribution to the further development of the overall diversity of crops and provides the starting point for subsequent generations. Therefore, a rich crop diversity calls for a diversity of breeding initiatives, because the diversity arises from the various individual capacities and outlooks of the breeders. The know-how of organic agriculture and organic breeding is likewise a public good that should be cultivated in the public interest. Today's trainings in both agriculture and for breeders have put their focus on techniques that can be used. As can be clearly seen from the foregoing, an extension and reorientation of education and training for organic agriculture is called for.

For cost reasons breeding in the last 70 years has moved world-wide from the largely public sector to the private sector. The large seed multinationals are the direct result of this trend. In close connection with the pesticide industry they develop only those varieties that promise high returns. The seed and pesticide package is very lucrative, but globally it works at the expense of diversity, health and the environment. Cultural property is only explored, not maintained. On the increase are orphan crops, neglected species that no breeder develops further because they cannot earn any money from it. Commissioning the state to take over maintaining and breeding these economically uninteresting species and to finance this with taxpayers' money is not really sustainable. Therefore new instruments for support are urgently required. A simple and easy to realise instrument could be a tenth of a percent crop levy that is imposed directly on each food purchase and could be used for financing any breeding concern that, in the interest of future generations, looks after the maintenance, cultivation and further development of the crop commons and its diversity. Annually in Switzerland alone this method would yield 40 million francs. This is ten times the total amount that the Swiss state currently allocates to agricultural plant breeding. In view of the existential importance of crop diversity in the light of current and future climate changes, intensifying and diversifying plant breeding is a top priority.

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