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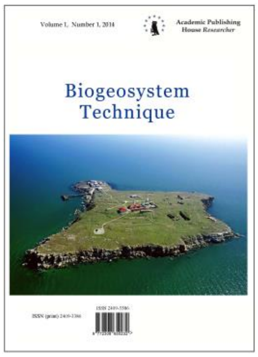

Is There a Nitrogen Deficiency in Organic Farming, and are the Yields in Organic Agriculture Lagging Due To Nitrogen Deficiency? And Can Conventional Agriculture Learn from the Mistakes of Organic Agriculture? (Critical Review)

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Abstract

In organic agriculture the yields are roughly 25 % lower than in conventional agriculture. And the quality differences are only small, save for pesticide residuals which are in general lower in organic products. Some scientists think the lower yields are caused by the slow mineralization of organic nitrogen. But in this article is demonstrated that the quality of the animal dung and the warm compost hinders the uptake of organic nitrogen and other organic nutrients. The dung and the compost in organic agriculture today are not treated well and because of this the plants are hindered in their growth. Their symbionts in the soil can't assist them in collecting the organically bound nutrients, because they are lacking or silenced. Above that the dung and the warm compost have lost lots of nutrients in the stables, during composting and while at the piles. Vermicomposts on the other side have less losses, better microbes and no growth limiting poisonous organic compounds. Compared to vermicompost, animal dung and warm compost give lower yields, inferior growth qualities and less resistance to pests and diseases. The adding of earth into the dung or the compost has comparable positive effects as vermicompost. The improperly treated dung and warm compost lead to crops which contain too much non protein nitrogen and probably also non protein sulphur. And the crops are not in balance for their other cations and anions. Just like the crops in conventional agriculture. Through this cows for instance don't become old and they produce a poor quality urine and poop. And the milk is also of poorer quality. So there is a lot to improve. In organic agriculture and in conventional agriculture.

Keywords: nitrogen deficiency, organic farming, organic agriculture, conventional agriculture.

1. Introduction

Already more than 200 years there is a clash between organic agriculture and chemical agriculture. It started around 1820 with the mineral theory (Sprengel) against the humus theory (Thaer). Or, in other words, chemical oriented scientists versus organic theorists. Thaer versus Sprengel and Liebig as mentioned… or Stoklasa, Frank, and Schanderl who studied the nitrogen

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assimilation by all plants versus the proponents of inorganic nitrogen who denied that assimilation by non leguminous crops; Jamieson versus Lawes in the phosphate battle; Hopkins – representative of the fertilizer industry – versus Howard and Lady Balfour, the two proponents of organic agriculture…

At the Wageningen agricultural university the last fifty years the conflict has hardened. The scientists who are convinced that artificial fertilizers are unmissable have done everything to stop organic research at this university. They used all means to oppose the organic research. That led to personal dramas. But a real scientific debate was not possible. At the background the fertilizer industry had a big influence through their funds and textbooks. There are at the moment at either side no people who are able to bridge the gap. The arguments of the scientists on the side of conventional agriculture circle around two themes: a. the yields of organic agriculture are too low to feed the world, and, b. the claim that the products of organic agriculture are healthier is not proven. The arguments on the other side, from the proponents of organic agriculture, emphasize the risks of artificial fertilizers, pesticides and genetic engineering for the environment, for nature and for men. Both sides have strong and valid arguments.

But both groups have more in common than they suppose. In order to bridge the gap the presuppositions of the two approaches have to be clarified. Both groups for example have only very summary ideas about what quality really is, and even here there is no agreement. The organic proponents for instance claim lower levels of nitrate in their products. But the proponents of conventional agriculture today say – in Western Europe - that nitrate in food is no longer a problem. And they deny or ignore simply that the nutrient density of the crops has gone down. But the nutrient density of organic crops is almost the same as that of the conventional agriculture. and contain also, like conventional agriculture, too little trace elements (Swoboda*, 2016; Dangour et al, 2009; Fan et al., 2008 ; Dimkpa, Bindrapan, 2016). A real stalemate.

Organic agriculture is not really ‘organic’ because in most cases the mineralization of its nutrients is at the moment the only way in which the plants can get in their nitrogen, sulphur, and other nutrients. As salt ions. Plants should be given the possibility to get their nutrients in an organic form. Through their symbionts, or directly by themselves (see part one)..

In this article some new arguments for a real organic agriculture will be worked out which can help to overcome the standstill. What we need is more reflection on the presumptions of conventional and of today organic agriculture and a thorough paradigm shift based on that reflection.

2. Discussion and results

Nitrogen in organic agriculture.

Yields.

The yields in organic agriculture are roughly 25 % lower than in conventional agriculture. But that is indeed a rough figure because if we zoom in, we see that there are big differences. And those differences are related to the following factors: the type of crop; annual versus perennial crops; and the regions where the crops are grown. The differences are small for fruit and oilseeds. Vegetables, potatoes and some grains, on the other hand, show large yield differences. The differences are smaller in developed countries than in underdeveloped countries. And there are even more nuances, such as with legumes that supply their own nitrogen, or the influence of the craftsmanship of the farmers (Seufert et al., 2012).

Mineralization?

Various authors have concluded that the differences in organic yields compared with conventional agriculture can be explained by a shortage of plant available mineral nitrogen (Seufert et al., 2012; Opdebeeck et al., 2004†). Sometimes a shortage of phosphorus is also mentioned to explain

* “Micronutrient deficiency is a common constraint in organic farming worldwide” (Swoboda, 2016)

† In 2019 I have done a preliminary investigation on this subject, based on the data of Opdebeeck et al. and on a great trial with potatoes by The Louis Bolk institute. This institute is founded in the Netherlands for research in organic agriculture. My report is written in dutch and contains a lot of empirical data (Nigten, 2019).

the differences in yield. In general, there is sufficient organic nitrogen present with good fertilization*, but it is not released quickly enough – not at the right time and not in the right amounts.

'The organic nitrogen in green manures, compost and animal manure is not transformed quickly enough from organic nitrogen into a mineral form, so growth is slow to start and the crop cannot fully grow out or continue to mature. As a result, the yields and the protein content lag behind', according to both authors.

The question is whether this statement is correct. At first sight, the facts seem to be correct. Yes, many organic soils contain more than enough organic nitrogen in case of regular fertilization (Lawes, Gilbert, 1858; Poschenrieder, Lesch, 1942; Hopkins, 1956). Nevertheless, the yields and the protein contents in organic agriculture are lagging behind. But is this because of a too slow mineralization? That is still the question. In fact, my central question. There are at least five other ways in which plants can get their nitrogen (see part one). But why do plants on most organic farms not use these possibilities? That is the real issue.

Let us look at it in more details.

Vermicompost, cow dung and warm compost.

A comparison between vermicompost, farmyard manure and/or warm compost shows that there are big differences in composition, performance and microbial life:

"Earthworms vermicompost is proving to be a highly nutritive 'organic fertilizer' and more powerful 'growth promoter' over the conventional composts and a 'protective' farm input (increasing the physical, chemical & biological properties of soil, restoring & improving its natural fertility) against the 'destructive' chemical fertilizers which have destroyed the soil properties and decreased its natural fertility over the years. Vermicompost is rich in NKP (nitrogen 2-3 %, potassium 1.85-2.25 % and phosphorus 1.55-2.25 %), micronutrients, beneficial soil microbes and also contain 'plant growth hormones & enzymes'. It is scientifically proving as 'miracle growth promoter & also plant protector' from pests and diseases. Vermicompost retains nutrients for long time and while the conventional compost fails to deliver the required amount of macro and micronutrients including the vital NKP to plants in shorter time, the vermicompost does" (Sinha et al., 2009).

So vermicompost delivers the required amounts of nutrients in time.

This was verified by: Bhatia, 2000; Bhatia et al., 2000; Sinha and Bharambe, 2007; Krunal, 2009, and by Dalsukh, 2009.

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* E. Hennig calculated that in a humus-rich soil where sufficient cobalt is present, enormous amounts of organic nitrogen are found in the soil: "*A soil with 4 % organic matter contains 120,000 kg (..) of organic matter in the top 20 cm per hectare. It is stated in the professional literature that humus contains about 5 % nitrogen. Based on this five percent, the 120 tons of organic matter have 6,000 kg of organically bound nitrogen. (...) In one hectare of land there is an amount of nitrogen in the top 20 cm that is more than enough to fertilize this one hectare with approximately 400 kg N for 55 years* "(Hennig 1996: 141-142). That must of course be: 15 years. 15 x 400 = 6000. I suspect that something went wrong with the translation. In calculating the amount of organic matter, Hennig assumed that a cubic decimeter of earth weighs 1.5 kg. Checking with moist loamy sandy soil from my garden shows that a liter of this soil weighs 1140 to 1200 g. But maybe it was too loose because I was scooping it up. Clay soil will be heavier.

Van Kessel calculated that a soil with 3 % organic matter contains 9000 kg N/ha in the top 30 cm. So with 4% organic matter it contains 12.000 kg N/Ha in the top 30 cm (Van Kessel, 2008). The difference is that Van Kessel states that the C: N ratio in soil organic matter is 10: 1 while Hennig says it is 20: 1. To decide how much nitrogen is in the top soil only measurements can give a definite answer. But a figure between 6000 and 9000 kg Nitrogen per hectare means there is a lot which the plants – at least theoretically – can get. And a consumption of 400 kg N/year is pretty much, 100-200 kg is enough for most crops. For some crops more is needed (and lost).

Hopkins gives the following data for phosphor, potassium (and nitrogen) in an average soil: "*Here are some figures from Cornell University in the U.S.A. In the soil studied, the figures for total phosphoric acid in the top four feet of soil showed a content that could, if it were all available, support normal rotation cropping for 367 years. For potash, the calculated period was 1,435 years. Speaking more generally about the same matter in this country, the late Sir Daniel Hall stated,'Roughly speaking, an average soil contains enough plant food for a hundred full crops*.' (Hopkins, 1956). Hopkins gives also the amount of nitrogen per acre in Prairieland in the USA before the farmers came: "*When the prairie land was ploughed, its nitrogen content was 6,940 pounds per acre*" (Hopkins, 1956). And ploughing alone gave a loss of 68 pounds per year per acre.

The research by Agarwal and Sinha demonstrates the following differences for the three main elements between warm compost from cow manure and vermicompost (Table 1).

Table 1. Content of nutrients in warm compost from cow manure and/or of worms

Nutrient	Warm compost from cow dung	Vermicompost
Nitrogen	0.4 – 1.0 %	2.5 – 3.0 %
Phosphor	0.4 – 0.8 %	1.8 – 2.9 %
Potassium	0.8 – 1.2 %	1.4 – 2.0 %

Important other nutrients contained in vermicompost are compared with nutrients in conventional anaerobic and aerobic composts in Table 2. The three composts were made from the same basic material: food and garden waste, but the differences were substantial, except for potassium.

The extremely high levels of iron and magnesium probably come from the earth particles of the weeds. In India, the grounds of the Deccan plateau for instance are very rich in iron and magnesium, and worms also "digest" the soil, depending on the type of worms used.

Table 2. Content of nutrients in vermicompost, aerobic compost, and anaerobic compost (Sinha et al., 2009)

Nutrient	Vermicompost	Aerobic compost	Anaerobic compost
1) Nitrogen(N)	9.500	6.000	5.700
2) Phosphorous (P)	0.137	0.039	0.050
3) Potassium (K)	0.176	0.152	0.177
4) Iron (Fe)	19.730	15.450	17.240
5) Magnesium (Mg)	4.900	1.680	2.908
6) Manganese (Mn)	0.016	0.005	0.006
7) Calcium (Ca)	0.276	0.173	0.119
(Sinha et al., 2009).			

The yields varied correspondingly to the kind of compost. The major differences are presented in Table 3.

Table 3. Agricultural effects of worm compost, cow manure compost and fertilizer on the growth and yield of wheat*

Treatment	Input/Hectare	Yield/Hectare
1) Control	(No Input)	1.52 t/ha
2) Worm compost (vermicompost) (VC)	2.5 t VC/ha	4.01 t/ha
3) Cow dung Compost (CDC)	10 t CDC/ha	3.32 t/ha
4) Fertilizer (CF)	NPK(120:60:40) kg/ha	3.42 t/ha

*Keys: N = Urea; P = Single Super Phosphate; K = Murete of Potash (kg/ha) (Sinha et al., 2009).

With cattle dung compost applied at 10 t/ha (4 times of vermicompost), the yield was just over 3,3 t/ha which is about 18 % less than that with vermicompost and that too after using 400% more conventional [cattle dung] compost.

Application of vermicompost had other agronomic, economic and environmental benefits. It significantly 'reduced the demand of water for irrigation' by nearly 30-40 %. Test results indicated 'better availability of essential micronutrients and useful microbes' in vermicompost applied soils. A remarkably significant observation was 'less incidences of pests and disease' attacks in vermicompost applied crops.

Agronomic impacts of earthworms and vermicompost vis-a-vis cattle dung compost and chemical fertilizers on growth and yield of potted wheat crops are shown in Table 4 (Sinha et al., 2009).

Table 4. Growth and yield of potted wheat under different fertilization

Biometrical data (average)	Control	Treatment 1 Earthworms **and** vermicompost	Treatment 2 Chemical fertilizer	Treatment 3 Cattle dung compost
1. Percentage of germinated seeds	50	90	60	56
2. Height of plant (cm)	34.16	85.22	39.97	37.3
3. Ear length (cm)	4.82	8.77	5.45	5.1
4. Number of seed grains per ear (pcs)	11.80	31.10	19.90	17.4
5. Number of tillers per plant (pcs)	1	2-30	1-20	1-2

In an overview study on vermicompost, Pathma et al. wrote in 2012:

"Worm composting is the best alternative to traditional composting. It goes 2-5 times faster. The material becomes more homogeneous. And the microbes in worm compost and warm compost differ widely.

Worm compost is also much richer in bacteria and fungi than warm compost. And it contains exactly the bacteria that belong to the rhizosphere[*]*. They bind carbon to the metal ions.*

Worm compost contains more humic and fulvic acids. These bind the released nutrients better, making worm compost less saline than warm compost.

The nitrogen present in the given material is made available faster and better. There are more nitrogen-binding bacteria and more growth-promoting substances.

Soil fertilized with worm compost showed better plant growth compared to soil fertilized with chemical fertilizer or cow manure. The quality of fruit and vegetables was better, with less heavy metals and less nitrate than with mineral fertilization" (Pathma, Sakthivel, 2012).

The importance of the right microbes is also proven by the use of vermicompost tea. Small amounts of these teas are enough for good results.

The work of the following three authors gives a good overview of the worm compost research (Sinha et al., 2009; Pathma, Sakthivel, 2012; Chaudhuri et al., 2016).

[*] Husssain came to the same conclusion: "vermicompost enhances the activities of beneficial microbes in the soil (Arancon et al., 2005; Yardim et al., 2006; Cardoza, 2011; Singh et al., 2013; Xiao et al., 2016; Hussain et al., 2020).

Chaudhuri et al. have researched the results of different dosages of vermicompost in pineapple cultivation. Among other things, they showed that loamy sandy soil turned into loamy clay soil in a short period of two years at a dosage of 20 ton of worm compost per hectare per year.

"A 20 % decrease in sand content and 10% and 30% increase in silt and clay contents respectively were noted in Plot T3 among different treatment plots. (..) Highest silt (27.5 %) and clay (32.5 %) and lowest sand (40 %) in fact were recorded in Plot T3" (Chaudhuri et al., 2016).

Chaudhuri et al. also found that the amounts of carbon and nitrogen in the soil increased with higher applications of worm compost. After application of the 30 t/ha of worm compost per year, the amount of organic carbon increased by 16 % and the total amount of nitrogen doubled.

Vermicompost tea.

My colleague, Mr. Kennes, sprayed in 2020 vermicompost tea over pastures, over corn for silage, and over fodder beet fields. Mr Kennes applied a mixture of vermicompost in water in concentration of 1% in the dose of 80 l/ha. Then the growth of corn, which had almost stopped as a consequence of the extreme drought of that season, restored. The pastures became green again. The same effect was seen in the fields with corn, and with fodder beets. The growth of the corn and the fodder beets went on till very late in the year. The fodder beets were harvested in December. The beets had even then no fungi nor deficiency symptoms.

Mr Kennes' results are very similar to those of Mr. Dixon who managed to overcome the 1826 drought without much difficulty. He had made compost from slurry, peat, swamp soil and ditch dredge. In 1839, Mr. Dixon was awarded a prize of the Royal Agricultural Society of England for his essay on his experiences with this method of composting:

"The full effects of this practice I first experienced in the dry season of 1826: I had some clovers which had been manured the previous winter; my land was soon covered with crop, and that so vigorous a one, that the hot weather did not overpower it. My cows, that summer, were tied up during the day-time, and in the night they were turned out into the pastures ; most of the stock in my district were much distressed from over-heat as well as from being short of food for some weeks ; milk yielded little butter, scarcely any for a time was offered in our large market-town : —no doubt that year will be remembered by many gentlemen on the Agricultural Society's committee. I, however, was under no difficulties on account of the season: my clovers produced plenty of food for my cattle, and in return they yielded as much milk and butter as I ever recollect from the same number" (Dixon[*], 1839).

Future research.

To my opinion there is only one explanation possible: the vermicompost tea contains the microbes which the land and the crops are missing. If this is correct, then it is really amazing that such small amounts of microbes make the difference. Not only for the growth of the crops, but also for protection aganist the heat and the drought and for the resistance against pests and diseases.

And are the microbes from the 'slurry, peat, swamp soil and ditch dredge' of Dixon comparable to these in the vermicompost tea? Further on in the third article about nitrogen we will see that mixing earth with manure or plant residuals gives very good results, because the nutrients are not lost.

Here is a challenge for science. Do microbes in vermicompost, vermicompost tea or in with earth and plant residuals enriched manure and compost really make the difference? Or is another explanation possible or necessary?

Summarizing.

Warm compost, farmyard manure and slurry are not (yet) suitable as food for the symbionts in the soil and for the plants for various reasons. With vermicompost, and with farmyard manure, slurry and plant residuals or compost mixed with earth, you can avoid these problems.

We see that the yields with organic material (i.e. vermicompost, or with earth enriched manure and compost) can be the same or higher than with artificial fertilizers. Also the quality of the plants, expressed as growth characteristics, is better with vermicompost.

[*] Mr. Dixon made two other remarks, worth to mention. 1. If you use 'most foul or weedy mould' plus liquid manure, the urine kills all wire worms, slugs and destroying insects, and weed seeds as well. 2. He planned to build a movable railway for the transport of the liquid manure to the fields, to make the compost heaps on the spot. In this way he hoped to save a lot of money for transport.

That needs more explanation because we have all learned – especially in organic agriculture – that warm compost, farmyard manure and slurry are 'the ideal plant foods'. Only in Biodynamic agriculture, based on the teachings of Rudolf Steiner, the use of slurry is forbidden. Also Rusch, the cofounder of organic agriculture in Switserland and Austria, had serious doubts about the use of slurry. He also advised the use of fresh materials (dung and plant residuals) ón or just under the earth surface. (Rusch, 1968).

For farmyard manure and slurry, I want to explain why this is usually not (yet) a suitable food for soil life.

Farmyard manure and slurry not (yet) a suitable food for soil life.

The urine of the cow

The cow's urine may be too rich in nitrogen because the animal is being fed a too protein-rich diet, or because the nitrogen in, for example, the grass or the concentrate has not been sufficiently converted into real protein. The feed then contains much nitrate, ammonium and other forms of nitrogen like urea and nitric oxide, not converted into protein. These compounds ensure that the plants don't grow well, and become out of balance. And consequently, the animal's digestion is not optimal. The excess of protein and/or inorganic non protein nitrogen does not end up in the milk as milk protein or in the meat, but is converted into urea by the liver, or directly removed as sodium nitrate (Swerczek, 2007). We find this urea – and probably also part of the sodium nitrate – In the milk on the one hand and in the urine on the other. Or it accumulates as sodium urate in the (toe) joints (gout) or the skin. This may also contribute to arthritis and hoof and skin problems. According to Bredon and Dugmore, an excess of phosphorus over calcium can also lead to hoof problems (Bredon, Dugmore, 1985).

Nitrate can also be converted by the body via nitrite, into nitrosamine or nitric oxide (NO). Neither is good for health. Nitrosamines are carcinogenic, and too much nitric oxide leads to disruptions in various biological control systems of animals and man. Nitric oxide participates in the pathogenesis of Alzheimer disease, but 'many questions need still to be elucidated' (Kadowaki et al., 2005). Nitric oxide is an intercellular signaling substance and a neurotransmitter. NO is also an important steering element for plants (Visser, 2010).

Not only cows and humans have health problems as a consequence of high NPN and high protein levels in their feed:

"Vegetables have been a significant part of human diet since time immemorial. Besides adding the elegance and attractiveness to a meal, vegetables are abundant source of vital minerals, vitamins and several biologically active compounds essential for maintaining human health. Most importantly, vegetables account for 70-85 % of total human nitrate intake [..]— ubiquitous within food and physiological systems (..)*; after ingestion, the ingested nitrate gets converted into nitrite by microflora in the oral cavity and in the gastrointestinal tract. This results in increased oxidation of hemoglobin to methemoglobin, leading to methaemiglobinnemia. Simultaneously, increased production of free oxide radical and free radical nitrate oxide** *occurs. These radicles predispose persons for carcinogenic and other effects. The other effects observed were increased infant mortality, abortions, birth defects, recurrent diarrhea, recurrent stomatitis, early onset of hypertensions, histopathological changes in cardiac muscles, alveoli of lungs and adrenal glands, recurrent respiratory tract infection in children, hypothyroidism and diabetes. Recent ongoing studies indicated that nitrate ingestion adversely affects the immune system of the body as well".* (Umar et al., 2013, Foreword).

"It has been suggested by McCall and Willumsen (1998) *that high rates of nitrate application lead to increase in plant nitrate content without any increase in the yield. Therefore, farmers who apply excessive fertilizers to ensure that nitrogen is not limiting for plant growth, may increase the nitrate content of crops to the levels potentially toxic to humans, without any increase in yield. (..) Moreover, there is an upper limit to the levels of N-metabolizing enzymes that the plant can accommodate* (Anjana, 2007)*. Therefore, the plant continued nitrate uptake due to its abundant availability in the soil but was not able to assimilate it. As a result, accumulation of nitrate in the plant to unsafe limits occurred*" (Anjana, Umar, 2018).

Consequences.

* This should be: nitrogen oxide, NO_x. Nitrate oxide does not exist (the author).

So you can have healthy urine or unhealthy urine (and everything in between). The first is relatively low in nitrogen in the form of urea, uric acid, hippuric acid and creatinine. The nitrogen absorbed by the body of the cow is in this case efficiently converted into milk or meat proteins. The unhealthy urine on the other hand is excessively rich in these nitrogen compounds or even in protein, due to inefficient digestion. Once the cow has urinated, the decomposition of the organic nitrogen in the urine begins, unless it is bound to earth particles and humus. The latter happens automatically when the cow walks outside (and the soil is rich in humic acids, and/or clay particles. Even sand can bind nitrogen (Frank, 1888).

If it is not bound and/or if the pH is too high, urea is converted into ammonia and carbon dioxide by bacteria that release the enzyme urease. That should be avoided as much as possible because you want to keep all the nitrogen and the carbon. The creatinine, which is also a constituent of the urine, can be absorbed directly by the plant roots (Schreiner, Skinner, 1912).

I have not come across much research into the question whether the plants can also directly absorb urea, uric acid or hippuric acid.

Dimkpa et al. suggest that plants can take up urea, but they need enough nickel for the conversion of urea in ammonium:

"*Prior studies with soybean showed that a Ni deficiency-induced regulation of the activity of urease negatively impacted N metabolism in the plant, leading to urea accumulation and necrosis of shoot* (Polaccao et al., 1999; Sirko, Brodzik, 2000)*"* (Dimkpa, Bindrapan, 2016). (..).

… Urea can be assimilated exclusively by urease in higher plants. Moreover, urease is the only nickel-containing metalloenzyme yet identified in plants (..) The importance of nickel for urease activity was demonstrated by the observation that urea-grown nickel-deprived rice (Oriza sativa) plants showed reduced growth and accumulated large amounts of urea due to reduced urease activity[*]*"* (Sirko, Brodzik, 2000).

But there is another conclusion in the article of Gerendás et al. (1998) which is important for the discussion about the risks of ammonia, nitrate and urea fertilizers:

"*Although the growth of plants with NH_4NO_3 was not affected by the Nickel supply, they accumulated endogenous urea due to arginase action in conjunction with low urease activity. It is clear that the Nickel status of a plant has significant consequences for the relative suitability of urea and NH_4NO_3 as nitrogen sources*" (Gerendás et al., 1998).

So not only urea can lead to urea accumulation in plants but also NH_4NO_3, ammonium nitrate.

Many farmers in the Netherlands use 'Kalkammonsalpeter' as a nitrogen fertilizer. Kalkammonsalpeter is $CaCO_3NH_4NO_3$. Sometimes it also contains magnesium. So the risk is that our crops also compose urea from NH_4NO_3. In order to find out if this is a serious risk we should measure the amount of urea in our crops. In our soils is nickel, but I don't know if our crops absorb it sufficiently. Remember that potassium and ammonium both hinder the uptake of many cations.

According to the overview of Schreiner and Skinner (1912) urea is harmful for higher plants, but not for all of them. Hippuric acid is slightly harmful, and uric acid is beneficial.

Cyanobacteria can also absorb urea directly, in addition to nitrate and nitrite (Herrero and Flores, 2019).

These cyanobacteria can then be "digested" by the plant roots as White describes. So also indirectly, the urea can be absorbed by the plants in the form of organic (bacterial) nitrogen. A safe way.

If the urine of the cows is too rich in nitrogen, it can cause burn spots in the grassland.

Poor digestion.

[*] And this has also consequences for human health, because the stomach bacterium Helicobacter pylorum, which is a normal habitant in our stomachs, can become dangerous if there is too much urea in the food: "*One of the most frequently mentioned examples in the recent literature is the urease from Helicobacter pylori because of its essential role in the pathogenesis of this microorganism and the high prevalence of this human pathogen*" (Eaton et al., 1991). So plants can accumulate nitrate, ammonia and urea. All three are u health burden for animals and men. One of the risks is the growth of pathogenic helicobacter pylorum. Ammonia in the intestines is also a risk for our brains (Galland, 2014).

If the digestion of the cow is not optimal, even more nitrogen losses will occur: namely via the cow's mouth. Through its respiration, the cow loses not only methane – about 100 to 160 kg/year[*] – but also ammonia (Regnault, Reiset, 1849; Reiset, 1863; Frere, 1863), and hydrogen sulfide (Voisin, 1963). Various measurements taken in the 19th century showed an average release of about 10 kg of ammoniacal nitrogen per cow per year via the mouth. In the 19th century there were many outbreaks of diseases among cows. Almost every few years (see the different editions of the 'Journal of the Royal agricultural society of England': 1839 – 1880) thousands of cows and sheep died from these diseases. With protein- or NPN rich feeding, as happens today, there will be even more ammonia from the mouths.

The harmful compounds – too much protein; NPN and NPS – are all released in the rumen where the wrong bacteria start working if the correct elements and trace elements for the conversion of nitrogen and sulphur into bacterial protein are missing or insufficient. Phosphine exhalation via the mouth was not measured in the 19th century. Nor today.

The correct balance of the macro elements is also important: not too much potassium, and sufficient sodium, calcium and magnesium. You get wrong bacteria if the rumen environment is not optimal, due to, for example, poor quality (silage) grass with high levels of potassium, or an excess of protein or NPN / NPS from roughage and concentrate in the rumen. The bacteria that break down the cellulose and hemicellulose into, for example, acetic acid and some propionic acid should prevail, not the bacteria that feed on an overdose of protein, nitrates, ammonium or urea and other forms of non-protein-bound nitrogen, or on non-protein sulfur and phosphor, without sufficient magnesium and trace elements to convert these compounds in bacterial protein. They also lower the pH. At too low a pH, you get proportionally more and more propionic acid and lactic acid according to Kaufman et al. (1980). Also, the conversion of acetic acid to methane should not get the upper hand, because that is a pure loss from the cow's point of view. If the rumen wall absorbs acetic acid well, it is converted into milk fat. According to Kaufman et al., the optimal absorption of the acids has everything to do with the right pH. If the acid concentration is too high, the pH shifts further down. Too much concentrate/protein and NPN, NPS lowers the pH.

A cow with poor digestion tries to get rid of the harmful compounds in every possible way: via the urine; through exhalation, through the milk and through the dung, and also via the skin[†]. Or the cow will pile them up somewhere in the body after neutralization with cations, if the discharge through these five routes is stagnant or inadequate. This occurs, for example, in the form of protein accumulation in the connective tissue (Wendt, 1983) or as sodium urate between the (toe) joints and in the skin. According to Swerczek, an American veterinarian, many cows have the potassium nitrate syndrome. And he describes in detail which symptoms are part of this syndrome. Grass tetany, he says, is the extreme form of this syndrome, and many cows don't get tetany but are bearers of its preceding stages. These animals are seriously weakened (Swerczek, 2007). Colleagues told me that in the slaughterhouses in the Netherlands there arrive almost no cows with a healthy liver.

Calcification is also a form of accumulation. Calcification in humans usually involves calcium phosphate. That is not surprising. The amount of phosphates in our diet is almost three times as high as the RDA of 600 mg/day (Seelig, 1981; Itkonen, 2015). To neutralize these phosphates, the body extracts calcium from the bones and teeth. As a result, these bones and teeth gradually weaken, which in turn leads to osteoporosis and weak teeth. Research on phosphate poisoning is now starting to gain momentum (Brown, Razzaque, 2015). We should check whether dairy cattle also suffer from too much phosphate. We fertilize our crops intensively with the salts of nitrogen, phosphorus and potassium – NPK. It should come as no surprise that these three elements are very often in excess. In any case, phosphate salts are harmful to plants, as Jamieson and his colleagues in the period 1880-1910 have shown in **the "phosphate battle"**. They were able to prove that turnips grew better and healthier on natural rock phosphate than on phosphate salts (Jamieson, 1910). Based on tests and scientific arguments during thirty years, Jamieson et al. won the

[*] 100 kg/year is based on research of Smink et al., (2003). Smink et al. based this figure on 1993 research by van Amstel. So this is older research. According to an overview by Rotgers, it is higher. Between 133 and 162 kg/year, depending on the calculation method (Rotgers, 2017).

[†] We know from sportsmen who eat extra proteins that part of the resulting ammonia can leave the body through the skin. Their sportswear smells like a slurry pit. So I suppose that the same happens with cows. Maybe this attracts the flies in the sheds.

phosphate war, but the fertilizer industry, with superphosphate, ultimately won decisively over science. Their economic power was too big to stop them.

The same for potassium. These are five conclusions from the evaluation by Khan et al. (2013) regarding potassium chloride:

"- Based on an evaluation of more than 2,100 field trials, Khan et al. finds that potassium chloride fertilization very often does not contribute to an increase in yield.

- Based on 1400 field trials, Khan and his colleagues conclude that the potassium chloride fertilization is harmful to the crop, the soil and the consumer.

- The higher the potassium / calcium ratio, the less root nodules and root nodules bacteria form on the roots of leguminous crops;

- Fertilization with potassium chloride is more harmful than fertilization with patentkali ($K_2SO_4.MgSO_4$), or potassium sulphate;

- High chloride levels in the soil promote the uptake of cadmium by plants" (Khan et al., 2013).

Theel did in 1933 measurements on hay, collected from all over Germany, and concluded that, compared to the amounts in the hay in 1880 and before, which Wolff had collected, potassium, sulphur and chloride, had almost doubled (Theel, 1933).

Arzet demonstrated in 1972 that potassium in animal feed had gone up further, and magnesium had gone down further since 1870 (Arzet, 1972).

Theel and Arzet didn't look at sodium, but from the data of David Thomas for vegetables in the UK we know that sodium also has gone down. Based on a comparison of 27 vegetables from 1940 and 1991, Thomas accounted that the vegetables in 1991 had 49 % less sodium. K/Na was 10 in 1940, and 17 in 1991[*]. In 1991, phosphorus was 9 % higher. Magnesium was 24 % less and calcium 46 % less. Potassium had gone down with 16 %[†]. In 1991, copper was 76 % less. And between 1978 and 1991 zinc had gone down with 59%, in no more than 13 years (Thomas, 2003).

More sodium in grass helps to convert non protein nitrogen into real proteins (Chiy, Phillips, 1993). Maybe in other plants this will happen too.

As a consequence, the potassium magnesium ratio in for example grass and grass silage became steadily higher (Figure 1).

The golden rule is that all aggressive anions – acid residues with nitrogen; phosphorus; chlorine or sulfur – above the physiological levels are, if not used for protein building, bound by the body to the cations of calcium, sodium and magnesium[‡]. In this way, they are neutralized. These cations are taken from the body-stores and replenished from the diet, if they are sufficiently available. And these neutralized compounds are quickly drained through the urine if the liver and kidneys are working properly. If the liver and the kidneys cannot keep up or are fattened or calcified, these substances accumulate in the body.

Calcification occurs in the most diverse places in the body and causes blockages, such as arteriosclerosis in the blood vessels or calcification of the connective tissue (calcinosis) or the brain. One of the most risky forms of calcification is that of the mitochondria. Kapustin relates elevated levels of calcium and phosphorus in the blood to mitochondrial damage and increased superoxide production in vascular cells (Kapustin et al., 2011).

[*] Today in 71 raw Dutch vegetables the potassium/sodium ratio is on average 16.8. I calculated this on the basis of Food data of RIVM. RIVM is the Dutch State Agency responsible for public health and Environment. And in a potato trial in 2012 all the potatoes of the thirteen different fertilizing schemes – organic and inorganic – had a potassium / sodium ratio of 225 to 1 (My calculations, based on data from Rietberg and van der Burgt, 2012).

[†] In a Finnish study was also shown that potassium had gone down (especially in cereals) in 30 years from 1970 to 2000, like most (trace) elements. Despite this the total potassium consumption from cereal and vegetable foods between 1970s and 2000s had gone up with 15 %. (Ekholm et al., 2007). A scientific mystery.

[‡] It is striking that potassium is never mentioned as an acid residue binder in the relevant professional literature. The research by Frassetto et al. (1998) does point to a different role of potassium: potassium bicarbonate acts as acid binder. However, the bicarbonate HCO_3^- is the acid binder: $HCO_3^- + H + > CO_2 + H_2O$. Both disappear through the breath.

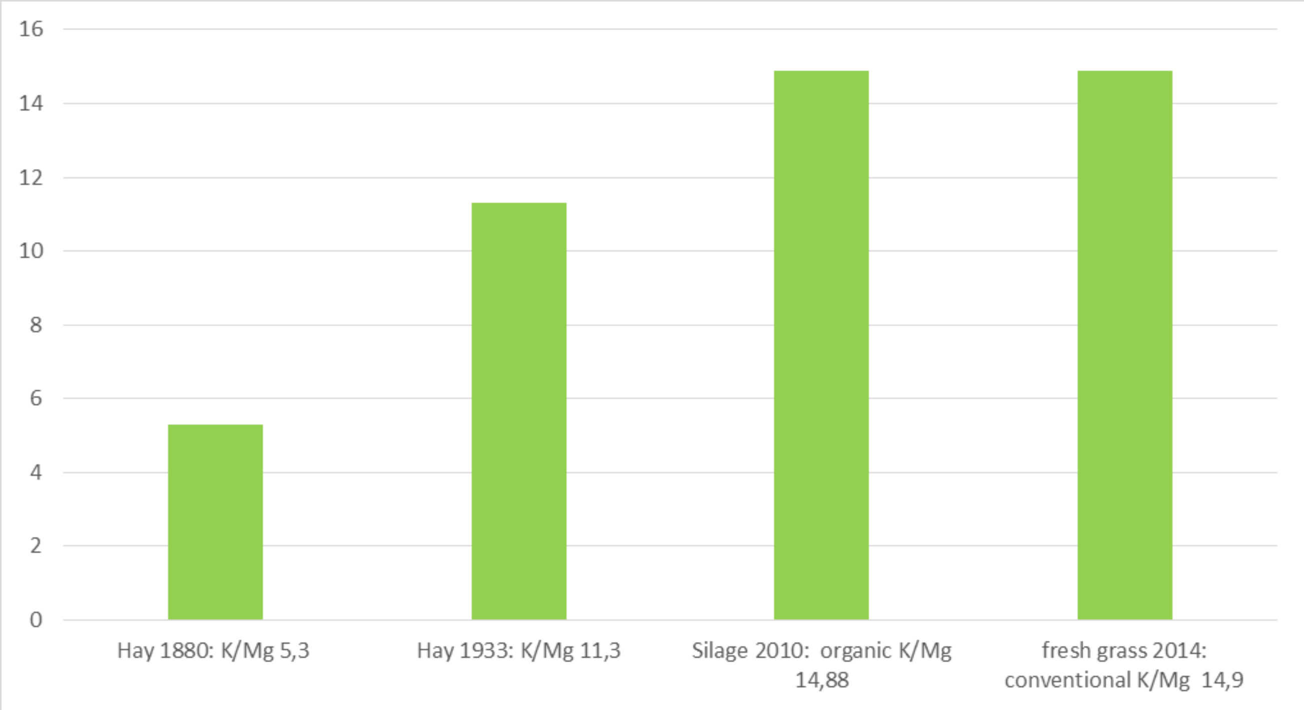

Fig. 1. K/Mg ratio in Hay and silage (1880–2010)

If the mitochondria calcify, the oxygen-rich combustion can no longer work properly, and the cell becomes a cancer cell that switches to lactic acid fermentation. Calcification is caused by too low magnesium levels in the food / feed. Then potassium and magnesium disappear from the cells, and their place is occupied by calcium, sodium and protons (Schroll, 2002). The cells calcify, become saline and acidify. All in one. The cell pumps don't work properly anymore.

Mitochondrial calcification is probably the missing link in Otto Warburg's work. Warburg stated in 1956 that the main cause for the development of cancer cells must be sought in mitochondrial dysregulation. He thought the cause of this were carcinogenic compounds such as arsenic acid, radiation, urethane and hydrogen sulfide* (Warburg, 1956). However, Warburg ignored the "normal dysregulation" of the mitochondria through calcification, which is a result of insufficient magnesium levels in our foods and drinks.

To my knowledge, the extent to which salinization† and acidification of the cell also play a role in causing cancer has never been investigated.

Calcifications often happen after the consumption of too much phosphate or oxalate, in combination with too little magnesium.

Sulfur can accumulate as sulfur stones (cistin), as homocysteine‡ or as hydrogen sulphide. Too much sulfur in cows leads to brain damage (polioencephalomalacia), or it causes strokes (Kobayashi, 1957) and hydrogen sulphide disregulates the cell mitochondria (see Warburg here above).

* It is interesting that Warburg mentions hydrogen sulphide. Voisin warned already in 1963 for the risks of this compound. Hydrogen sulphide is one of the compounds which are released when the digestion is disturbed. Maybe the same is true for urethane. And arsenicum was very often used as a pesticide in agriculture in the past.

† It is more correct to say sodium accumulation, because I don't know if also chloride goes into the cell.

‡ On Wikipedia you can find a whole range of symptoms and conditions under the keyword Homocystinuria. In that case, the blood and urine always contain too much homocysteine. This homocysteine normally has to be converted into cisteine or back into methionine, but this conversion can stagnate due to a lack of magnesium and vitamins B9, B12 and / or B6. "Hyperhomocisteinemia was detected in 69.8% of all the [elderly] subjects evaluated. The study showed that 76.2% of the men and 66.4% of the women had high Hyperhomocisteinemia levels (Janson et al., 2002). High Hyperhomocisteinemia has a strong correlation with vascular diseases.

Nitrogen stacks as ammonium, sodium nitrate[*], NO, proteins / beta-amyloids[†] or urea and urates, etc.

When the whole body is calcified, it is called calcinosis universalis, general calcification. I found a too visual description of this phenomenon in Roovers (1937). Sodium citrate (citras natricus) (oral) in combination with calcium (Calcium Sandoz: intravenous) turned out to be a well working medicine in the case study of a five-year-old girl described by this medical doctor.

Carson's research (Carson, 1998) shows that bacteria are almost always hidden in the accumulated calcium compounds. The so-called nanobacteria. Roovers' description indirectly confirms this. The girl who suffered from calcinosis universalis had regular temperature increases before her treatment. Often 38 degrees, which can indicate chronic, low-grade inflammation – Inflammation that does not get resolved, but continues to persist. Five weeks after starting the treatment, the girl developed a high fever for many weeks. During the fever, "*large and fluctuating swellings, red and warm to the touch, developed. The swellings contained calcium grit*"[‡]. After months, the definitive recovery started. X-rays showed that the calcium deposits had disappeared from her entire body.

Maybe we can use this therapy of Roovers against calcification today: the girl – five years old – got 3-4 g sodium citrate per day. That is a lot for a girl of say 18 kg (165 mg sodium citrate/kg body mass). An adult of 70 kg should get more – 11 to 15 g. That seems to me very much, so for safety reasons a medical doctor should give say 8 g/day to start with. Plus 5 cm^3 (or some more) calcium Sandoz intravenous as Roovers gave the girl. More recently, Schmiedl et al advised potassium citrate and magnesium citrate for the treatment of calcifications:

"…the combination of potassium citrate and magnesium citrate, which shows enormous anticalcification efficacy, deserves high priority in clinical trials aimed at evaluating strategies for the prevention of stones" (Schmiedl et al., 1998).

My assessment is that first, there are the calcium phosphate accumulations, and then the growth of the harmful nanobacteria. In other words, first the environment changes, then micro-organisms that feed on it and are harmful to humans. But according to Kajander et al. the nanobacteria produce the calcifications as an envelope 'at physiological phosphate and calcium concentrations' (Kajander and Ciftcioglu, 1998). But they forgot to look at the magnesium level. Calcification offers a nice test case to find out if magnesium is the missing link. From the literature, we know that magnesium prevents calcification (Seelig, 1980; Driessens and Verbeeck, 1988). And magnesium – especially magnesium chloride - improves our natural resistance (Neveu et al., 2009).

The faeces of the cow.

Poor digestion leads not only to nitrogen-rich urine and smelly breath, but also to faeces that are abnormal. On many dairy farms in the Netherlands, the cows are permanently suffering from diarrhea. As far as our measurements in 2019 were correct, there are in this respect no big differences between organic and conventional dairy farms, but these measurements were based on only one year with great variations in the weather: a severe drought, followed by much rain. The grass was as a consequence extremely rich in crude protein (Vanhoof, Nigten, 2020).

Measurements by Wigle Vriezinga show that the dung often contains a lot of undigested fibers and resistant starch. That starch, together with unused acetic acid in the manure, leads to

[*]The presence of sodium nitrate in the milk would also explain why an increased amount of sodium in the milk is indicative of mastitis. The nitrate is of course a fantastic food source for bacteria. I suppose, sodium is not the mastitis-causing element. The nitrate is. According to Nele nitrate in milk can vary between 20 µg/100 g and 1240 µg/100 g (Nele, 2006). The maximum is sixty times more than the minimum.

[†] Amyloid.. a protein that is deposited in the brain, the liver, kidneys, spleen, or other tissues in certain diseases. "Studies have shown that amyloid deposition is associated with mitochondrial dysfunction and a resulting generation of reactive oxygen species (ROS)". Source: Wikipedia, english, keyword: amyloid. Wikpedia refers to a study of (Kadowaki et al., 2005). The authors link ROS and NO to Alzheimer disease: "These findings suggest that ROS and NO may be important mediators of Ab [= amyloid Beta] -induced neuronal cell death in the development of AD" (Alzheimer disease).

[‡] The words chalk grit and calcification are misleading in that the reader quickly thinks that it is pure calcium. However, these are calcium compounds, mostly calcium phosphate and calcium oxalate. And the acid residue is leading in our diet. There are also situations where it is the other way around. Then a cow gets, for example, too much calcium in the form of calcium carbonate in the dry period. Then the body extracts phosphorus from the feed or the bones to neutralize the calcium.

methane formation (oral statement by Sentobin, Vogelsang), which means that the slurry pits which are covered with low grade methane emission deposits (foams) can explode. As has happened sometimes in the Netherlands. A few cows disappeared into the slurry pit and died.

The undigested fibers lead to a crust on the slurry. Both the foams and the crust prevent gas exchange from the pit into the air.

Characteristic of good cowpats is that – in the pasture – dung flies come immediately, and dung beetles and dung worms etc. etc. And that is again a feast for the meadow birds (de Ark, 2020; Wesseling, 2019). Jelmer Buijs' research states that residuals of insecticides, vermicides, cleaning products and other poisons ensure that no insects, or very few, live around the slurry pit and that the cowpats are no longer attractive to insects (Buijs and Samwel Mantingh, 2019). This connection is disputed by Rotgers (2019). Perhaps the quality of the dung is the missing link…

From the research of Buijs (Buijs and Samwel Mantingh, 2019) we learn that there are many, many residuals of pesticides, cleaning products and veterinary medicines in the dung, the fodder, the concentrates, and the soil, even in organic dairy farms (but there on average less than on conventional dairy farms). They have proven that there is a strong relation between these residuals and the missing beetles and insects in the pastures:

"With the collected information we cannot conclude otherwise than that the ecosystem of the livestock farms is seriously threatened by the multiplicity of pesticides that are present there. This was further confirmed by the fact that in fresh manure of the cows no, or hardly any, Coleoptera (beetles) were found on most farms. In the manure of farms where concentrated feed and hay with relative high concentrations of insecticides were used, the occurrence of beetles in fresh manure was significantly lower" (Buijs, Samwel Mantingh, 2019).

And look at the pastures where the cows defecate and draw your own conclusions. Usually, the cowpats remain completely untouched by insects, beetles and worms. You can also see that the cows almost always avoid the grass around the pats. If you travel crisscross through the Netherlands by train, you can see this clearly. Because you sit higher than the surrounding pastures, you see cow pats everywhere with lush growing grass that is not eaten.

Summarizing

The fodder and the concentrate of cows contain too much protein and/or NPN and NPS (Schmack, 2020; Swerczek, 2007). And are not in balance for its cations too. Potassium is high and sodium, calcium and magnesium are low. Silicon is probably also too low, but it is mostly not measured at all. The K/Mg ratio has gone up since 1880. The same for the K/Na ratio.

The cows are unhealthy because of this low fodder and concentrate quality. There is an accumulation of nitrogen and probably also sulphur compounds, and a calcification of the soft tissues. Swerczek gave it a name: the potassium nitrate syndrome. But the stocking of risky compounds is wider than that. Also in humans, we see comparable health problems.

Cows try to get rid of the accumulations. Partly they end in the urine and the poop. Both become also unhealthy and out of balance. They rot and stink. The urine and the poop are above that enriched with pesticide, insecticide, vermicide and antiobiotic residues. Through this, the number of insects and meadow birds has gone down dramatically.

Artificial fertilizers give comparable problems and losses. Superphosphate weakens the plants just as potassium chloride. Ammonia, nitrate and urea accumulate in the plants and this attracts pests and diseases. Probably the same applies for sulphur. The sulphur in hay in 1933 had almost doubled since 1880 (Theel, 1933).

The reasons for lower yields and less quality in organic agriculture.

So here we have the reasons why the yields in organic agriculture are suboptimal, and the crops not that healthy:

- There is often too much protein, and/or NPN and NPS (and NPP?) in the fodder and the concentrates for the cows, pigs, chickens etc. This ends in part in the deep litter manure and the slurry, together with putrefactive bacteria and their toxins;

- A lot of nitrogen, carbon, sulphur, phosphor and other nutrients are lost from the slurry pits and deep litter stables, and during warm composting;

- There is imbalance of the macro-elements in the feeds: too much inorganic nitrogen, sulphur and potassium, and probably also too much phosphor. And too little sodium, magnesium, calcium and silicon. Especially the healing role of sodium and magnesium, as well as the protective role of silicon in roughage and concentrate, is heavily underestimated;

- This results in farmyard manure and slurry which is also not in balance and not healthy. With too much NPN, NPS and potassium. They contain putrefactive bacteria and other harmful microbes. And these produce rotting products and toxins. The rotting compounds, and putrefactive bacteria and their toxins inhibit the growth of the plants and suppress the symbiotic bacteria, viruses and fungi;

- And warm compost also has the wrong bacteria, and it has lost a lot of nitrogen, carbon, phosphor, potassium and other macro- and trace elements during processing. Heating leads to wrong microbes, mineralization and big losses.

- A number of the organic farmers use antibiotics, cleaning agents, insecticides and vermicides for their animals and in the stables, because the animals health is suboptimal, as the fodder and concentrates are out of balance. The animals get fertility and birth problems, abomasum twisting, mastitis and foot diseases, and attract flies and intestinal worms, which have to be controlled with antibiotics, fungicides, insecticides and vermicides. The residuals of these products end in the dung and from there present in the soil and the grasses, and other fodder products.

Together all these factors hinder the uptake of organic nitrogen by the plants, and block the nitrogen fixation in the soil and above the ground on the leaves and stems. So in this situation the plants can only grow on 'mineralized' nitrogen – ammonia and nitrate – and mineralized phosphor, potassium, calcium, sodium, sulphur and magnesium etc.

The release of the nutrients from manure and compost starts already during the winter, even when the soil is cold. And the microbes eat them (Krasil'nikov, 1958). But when the manures and composts are given in the early spring, the regular practice in the Netherlands, the mineralization must still start and the toxins and growth inhibiting rotting products hinder the plants. When the soil is cold, nitrate is taken up before potassium can be taken up, and potassium is taken up before magnesium is taken up. The putrefactive bacteria produce ammonia and nitrate and rotting products and toxins from organic materials, which hinder the growth (Schreiner, Skinner, 1912). The plants can't get help from their symbionts to get organic nutrients.

Domagała-Świątkiewicz and Gąstoł compared a.o. ammonia and nitrate in organic and conventional agriculture in Poland. (Domagała-Świątkiewicz, Gąstoł, 2012). Both are lower in organically grown products than in conventional products in this Poland study. But still considerable. I reviewed their results in: Nigten, 2019. Some studies which compare the nitrate level in organic and conventional products conclude that nitrate in organic products is the same as in conventional products, or slightly lower (de Waart, 1998). According to Dangour et al. nitrate is definitely lower in organic products (Dangour et al., 2009).

With artificial fertilizers – ammonia, urea, nitrate, potassium chloride and superphosphate – you avoid the barriers consisting of rotting bacteria, their toxins and growth inhibiting organic compounds, but these artificial fertilizers also result in crops which are not in balance and unhealthy. So the only way out is the production of amino acids, proteins, nucleic acids and organically bound cations and anions from the manure and from the organic residuals from plants, plus a plant friendly rhizobiome.

Mixing earth with manure and/or plant residuals, and conversion of manure and plant residuals by worms into vermicompost give good solutions.

Urea madness.

In 2016 Mr Schmack, published a book, titled "Die beschädigte Kuh im Harnstoffwahnsinn" (The damaged cow by the urea madness), which has been translated into Dutch and published by "At the Origin" (Schmack, 2020). The word "urea" refers to the fact that the amount of urea in the milk is always used as a measure of whether the animals are getting adequate protein. And by urea madness, Schmack means that the farmers on average maintain a much too high urea number in their milk as the standard. The maximum urea content is, according to Schmack, 10 mg/100 ml milk or less. Almost all farm scores are higher, too much higher. At current German feed recommendations, the urea number in Germany is 25 mg / 100 ml of milk. And 35 mg for high yielding cows (Schmack, 2020).

The underlying "theory" is that the cows must get a lot of protein in order to be able to give a lot of milk. At Wageningen University, the research into milk and animal feed, and the suppliers of animal feed, are vigorously perpetuating this myth. This costs farmers a lot of money and has seriously affected the health of the dairy herds. And what does this mean for the quality of the milk and meat? See for the quality of milk Appendix 1.

My assessment of the risks of ammonia, nitrate and urea that humans ingest through vegetables, fruits, potatoes and animal products is in line with Schmack's findings. However, the damage these compounds cause to cows is much greater and much more systematic, according to Schmack's research, than I had already feared. Systematic means that almost no dairy farm avoids it. Schmack then points out that this primarily leads to seriously damaged livers and kidneys. But also the other known livestock diseases, such as fertility problems, abomasum twisting, udder inflammation, paralysis, and leg problems can be traced directly to this excess of nitrogen that the animals ingest. Schmack considers the role of bacteria, viruses and fungi in the development of livestock diseases to be secondary."80 % of livestock diseases can be explained by the excess of protein in the feed", according to Schmack (2020).

Schmack's assessment is entirely consistent with that of an American veterinarian, Swerczek (2007). But Schmack has worked them out even more thoroughly at a detailed level.

It won't be much better in humans. The Dutch Kidney Foundation reports the following:

"1.7 million Dutch people[*] *have chronic kidney damage. People with chronic kidney damage are at an increased risk of kidney failure and cardiovascular disease. For example, someone aged 55 with a severely reduced kidney function may die 12 years earlier than average".*

The Dutch Liver Patients Association writes:

"About 250,000 people in the Netherlands have to deal with an acute or chronic disease of the liver or bile ducts. This can be caused by:

- *a viral infection,*
- *an autoimmune disease,*
- *lifestyle,*
- *hereditary burden,*
- *or, for example, long-term exposure to alcohol or drugs".*

Ammonium poisoning does not occur in the story of the Liver Patient Association. The amounts of nitrate, ammonium, nitric oxide, nitrite, nitrosamines and urea in the food are also not measured by the RIVM. All these compounds contribute to kidney and liver poisoning.

According to a UMC[†] Utrecht employee, fatty liver disease is much more common than chronic kidney damage:

"(..) fatty liver disease occurs in about 90 % of overweight people, which is equivalent to a quarter of the world's population[‡]*"*

With fatty liver you are not yet sick, according to the employee. But it can end in liver damage: fatty liver => hepatitis => cirrhosis.

I have not been able to find hard figures in the Netherlands about how many people actually have liver disease. An important reason for this is that livers can recover and that they can continue to function on a small amount of healthy tissue, while a big part is already sick….until the moment the livers can no longer function on the small healthy part, and then the damage is irreparable.

A study on liver diseases by Anthony Williams shows a much more serious picture as far as the liver is concerned. Williams says that nine out of ten livers in humans are sick. And also that many other systems in our body are diseased by a sick liver. But nitrate and ammonia are almost lacking in his work. It is all about fats (Williams, 2018).

Galland has demonstrated that "*Bacterial enzymes may produce neurotoxic metabolites such as D-lactic acid and ammonia*". And he concludes: "*The only mechanisms with a high level of proof in humans are the neurotoxic effects of ammonia in HE [hepatic encephalopathy*[§]*] and of D-lactic acid in short bowel syndrome".* (Galland, 2014).

[*] The Netherlands has a population of 17,777,085. So almost 10 percent has a chronic kidney damage.

[†] UMC is the University Medical Center in Utrecht, the Netherlands.

[‡] And these are the data for obesity in the Netherlands: More than half of the adults in the Netherlands are overweight (BMI (=Body Mass Index) higher than 25). This has emerged from research by the Central Bureau of Statistics, 12.7 percent of all people – four years and older – even have some form of obesity (BMI over 30). (CBS, 2019).

[§] Hepatic encephalopathy gives these symptoms: "The mildest form of hepatic encephalopathy is (..) experienced as forgetfulness, mild confusion, and irritability. The first stage of hepatic encephalopathy is characterised by an inverted sleep-wake pattern (sleeping by day, being awake at night). The second stage is

The ammonia in Gallands article is produced by bacteria, but we may suppose that ammonia from plants or animal products has the same effect. The quantity is of course decisive.

3. Conclusion

The yields in organic agriculture are roughly 25% lower than in conventional agriculture. On most organic farms, mineralized nitrogen and sulphur are the only nitrogen and sulphur compounds for the plants to grow on, and there is not enough of it for the plants to create a good yield. The plants are unable to take the organic nitrogen and sulphur etc. from the soil. Both are normally sufficiently available.

Comparisons between warm compost, cow dung compost and vermicompost show that only with vermicompost the plants get enough nitrogen in the right form. And the plant characteristics during growth are proven to be better with vermicompost. The bacteria in vermicompost are the bacteria that belong to the rhizosphere, which is not the case for the microbes in warm compost and cow dung (compost).

Vermicompost contains more humic acids. These bind the released nutrients better, making vermicompost less saline than warm compost and cow dung. The nitrogen and other nutrients present in vermicompost are available faster and better.

Stimulated by vermicompost, the earthworms in the soil can break down the loamy sand particles into loamy silt and clay.

And vermicompost tea can help to overcome severe droughts. The same for cattle manure mixed with plant residuals and soil.

The urine and poop of the cows is very often not healthy because of too much protein, and/or non protein nitrogen and non protein sulphur in their feeds. These compounds – nitrate, ammonia, urea, hydrogen sulphide etc. – disturb the health of plants, animals and men after accumulation in these organisms. In animals and humans, there is also another kind of accumulation, which disturbs their health: calcification of the soft tissues of their bodies.

Very often the level of potassium in plants is much too high, and the sodium and magnesium level much too low. Higher sodium gives lower potassium, plus higher magnesium and calcium as well. Sodium in grass helps to convert non protein nitrogen into real proteins. But most crops are in disbalance for their cations. And ammonium and potassium hinder the uptake of silicon and other cations by plants, which lowers their natural resistance further.

During the 'phosphate battle' Scottish scientists have proven that superphosphate weakens the plants grown on this salt.

In organic agriculture, just as in conventional agriculture, plants and animals are not healthy because their 'food' contains too much NPN, and is not in balance for their cations and trace elements. Their crops and fodder grow, like in conventional agriculture, on inorganic salt ions. Many organic farmers have to use pesticides and antibiotics to repress these diseases. So todays organic farming has much in common with conventional farming.

The inorganic nitrogen is not a safe plant food, and that plants can uptake organic nitrogen from the soil or nitrogen from the air. But the results of Lawes, Poschenrieder and Lesch, and Hopkins demonstrated that the uptake of organic nitrogen from farmyard manure is often a problem, even if there is enough organic nitrogen in the soil. Giving warm compost does not solve the problem either, as the comparisons with vermicompost show.

But at the same time not all organic nitrogen compounds are a good food for plants. Many rotting N containing products from manure, slurry and warm compost also disturb or slow down the growth of plants. The putrefactive bacteria, which are producing the rotting, are overruling the

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marked by lethargy and personality changes. The third stage is marked by worsened confusion. The fourth stage is marked by a progression to coma. More severe forms of hepatic encephalopathy lead to a worsening level of consciousness, from lethargy to somnolence and eventually coma. In the intermediate stages, a characteristic jerking movement of the limbs is observed (..); this disappears as the somnolence worsens. There is disorientation and amnesia, and uninhibited behaviour may occur. In the third stage, neurological examination may reveal clonus and positive Babinski sign. Coma and seizures represent the most advanced stage; cerebral oedema (swelling of the brain tissue) leads to death". Source: wikipedia english. Keyword: hepatic encephalopathy.

symbiotic bacteria. Especially when the slurry, the manure or the warm compost is given in spring, while it is still rotting.

In the next article about nitrogen, we will show the simple solutions for these problems in organic and conventional agriculture.

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Appendix 1

Milk quality has decreased

Cow milk in the Netherlands is no longer suitable for calves (Table 5). According to Agrifirm*, Sprayfo and the Flemish ministry of Agriculture, the quality of cow milk is low.

Table 5. Cow milk no longer suitability for calves in the Netherlands

The milk is too fat (it contains two times more fat than the calf needs). The calves are at risc of getting diarrhea.They can't metabolize the fat properly.
The cow milk contains 1,5 times the amount of protein a calf needs. Too much urea in the milk is a risc†.
The magnesium content should be twice as high (Flemish Ministry of agriculture)
The copper content is 8 times too low
The selenium content is 16 times too low
The iron content is 16 times too low
The manganese content is 33 times too low
The vitamin B1 content is too low;
The vitamin A is 2,5 times too low
The vitamin D3 is 10,3 times too low
The vitamin E content is 15 times too low according to the Flemish Ministry of Agriculture.

The exact amount of urea in the milk – much too high according to Schmack (Schmack, 2020) – is not listed in this overview, nor the amount of nitrate in the milk which can vary sixty fold (Nele, 2006).

According to a study of Masterjohn also the amount of vitamin K2 – not mentioned here above – has gone down:

"*Commercial butter is only a moderate source of vitamin K_2. After analyzing over 20,000 samples of butter sent to him from around the world, however, Price found that the Activator X [= vit K_2] concentration varied 50-fold. Vitamin K-rich cereal grasses, especially wheat grass, and alfalfa in a lush green state of growth produced the highest amounts of Activator X, but the soil in which the pasture was grown also profoundly influenced the quality of the butter. The concentrations were lowest in the eastern and far western states* [in the USA] *where the soil had been tilled the longest, and were highest in Deaf Smith County, Texas, where excavations proved the roots of the wheat grass to pass down six feet or more through three feet of top soil into deposits of glacial pebbles cemented together with calcium carbonate. It was this amazingly vitamin-rich butter that had such dramatic curative properties when combined with*

* Agrifirm – a dutch company that trades in seeds, animal feed and fertilizers - published data on cow milk quality in order to promote the use of artificial milk for calves which they are selling themselvs. They got the data from one of the biggest Dutch Milk dairies "Friesland Campina'. After critical questions of farmers and others they removed the data from their website. Sprayfo is another seller of artifical milk for calves.

† The average of the last seven years (2013 – 2020) of the Urea number (urea in mg/100 gram milk) in Dutch milk was 22,5 (Veeteelt, 2021). Schmack advizes max 10 for urea in milk (Schmack, 2020).

high-vitamin cod liver oil and nutrient-dense meals of whole milk, whole grains, organ meats, bone broths, fruits and vegetables" (Masterjohn, 2008).

The butter of Deaf Smith county was send all over the USA because of its health promoting qualities.

The groundwater of Deaf Smith county is very high in iodine, magnesium and trace elements. Farmers used this groundwater to irrigate their crops. The bones and teeth of this area contained five times more magnesium than the bones and teeth elsewere in Texas. In this area people had no health problems with bones and teeth (Barnett, 1954).

In the same article Masterjohn describes the many functions of vitamin K_2 in our body. Their role in our brain is one of them:

"*Vitamin K_2 supports the enzymes within the brain that produce an important class of lipids called sulfatides. The levels of vitamin K_2, vitamin K-dependent proteins and sulfatides in the brain decline with age; the decline of these levels is in turn associated with age-related neurological degeneration*[*] *Comparisons of human autopsies associate the early stages of Alzheimer's disease with up to 93 percent lower sulfatide levels in the brain*" (Masterjohn, 2008).

Too high levels of sulfatides are also a risk. But vitamin K_2 regulates the sulfatide concentrations in the brain (Tsaioun, 1999).

[*] Masterjohn refers to the following article for this conclusion: Denisova, Booth, 2005.