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GLYPHOSATE — A LOVE STORY. Ordinary Thoughtlessness and Response-ability in Industrial Farming

Birgit Müller

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Abstract :

More than 8.6 billion kilograms of glyphosate have been used worldwide since the 1970s. Herbicide tolerant crops became the lynchpin of the technological revolution for large-scale farming first in the US and Canada, and now in Europe. Zero-till farming as a production scheme and a world view, is based on simplifications promoted by a handful of transnational corporations with the complicity of politicians looking for easy solutions for problems, such as climate change, erosion and the hunger in the world. At the same time, the massive use of glyphosate is branded as an endocrine disrupter, causing cancer, male sterility and infertility. It interferes with soil bacteria and acts on the equilibrium of soil fungi. Glyphosate resistant crops connect farmers to far away consumers ingesting the food they grow together with the traces of chemicals. Farmers intra-act with the myriads of life-forms of the soil eco-system. How do they perceive the life in the soil, when they spray chemicals? The article explores the political dimensions of the agency of both humans and non-humans to understand the effects of the modernizing project of zero-till, as well as to identify spaces and scales of possibility from where alternatives can emerge.

Keywords: Agrochemicals, Responsibility, Organic Farming, glyphosate, manipulation of opinions

I first came across John Hart¹ one of the biggest farmers in the area around Carlston Saskatchewan, in 2008, on a Monsanto website. In midst of a sea of blooming canola spreading to the horizon, he stood clad in a red shirt, bathed in the golden evening light, and told his audience, that with the advent of biotechnology and the development of glyphosate resistant canola branded as Roundup Ready, exiting times had come for farming. Zero tillage, he asserted, had allowed him to save time to expand the farm and spend more time with his family: “I break it down to the basics, in that I am improving the structure of my soil with

¹ All names of persons and places are pseudonyms.

zero tillage; I am using less pesticide. It is better for the environment. We have less soil erosion than in the past. That's got to be good for a lot of other people than just myself. We are increasing the wildlife habitat. We use less fuel per acre. That means less greenhouse gas emissions. What I am doing on my farm is to the benefit of all society.” I was intrigued. I knew about John Hart because he was one of the farmers who had signed an affidavit in favour of Monsanto in the patent infringement case in front of the Supreme Court that pitted the corporation against the Saskatchewan farmer Percy Schmeiser (Müller 2006). Why would a large farmer show up in an advertisement, step in for a multinational corporation and expose himself to public scrutiny?

This article looks at zero-till farming as a production scheme and a potent world view, which is characteristic of what James Scott (1998) calls the ideology of “high modernism”. It seeks to explore the political dimension of zero-till practices and ideologies focusing on the agency of both, humans and non-humans — weeds, fungi and soil bacteria. The master plan of zero-till is based on a series of simplifications promoted by a handful of transnational corporations as an easy solutions for complex problems, such as climate change, erosion and the hunger in the world. At the same time, the massive use of glyphosate is accused of being unhealthy: an endocrine disrupter, causing cancer, male sterility and infertility. It interferes with soil bacteria and acts on the equilibrium of soil fungi.

How do farmers like John Hart perceive these accusations? How do they relate to the life in the soil that they spray with chemicals and to the far away consumers who eat their crops together with the residue? Rural sociologists have long identified an “erosion of the ethical attitudes and behaviours of farmers” because of growing constraints in decision-making, coupled with increases in economic pressure (Hendrickson & James 2005: 270). In my own

anthropological research I go beyond an abstract ethical approach to farming and explore the multiple practices and experiences of farmers at work. I look at how industrial farmers approach some of the momentous decisions about their production – which, while obviously bounded in political economic pressures – involve difficult philosophical questions about the nature of farming. I accompanied twenty-five grain farmers in the vicinity of Carlton, Saskatchewan in their daily farming routine over a period of fifteen years. In addition, I spent time with ten organic farmers in different parts of the province. The method I used was participant observation. I sat with farmers for hours on their tractors, combines and pick-up trucks, observing their work, discussing technical details and getting familiar with their views on the economy, the political system and the weather. I began fieldwork in the summer of 2004 for a month and returned almost every year until 2019 for a period of two to eight weeks. In 2008, I followed several farmers repeatedly during the entire growing cycle from April to November. Over the years the number of farmers I visited varied, some quit farming, new ones entered the fray. The questions and the farming methods I was interested in, evolved together with contractual arrangements and farm-politics. Long-term fieldwork allowed not only to become familiar with the minutiae and transformations of farming practices, but also with the worldviews and values of the different farmers I became acquainted with. I explored the ways in which farmers felt responsible for the food they grew and for the chemicals they applied; how they navigated ethical and practical considerations while they were exposed to immediate economic pressures and tried to maintain certain levels of productivity, contain costs, manage debt and fulfil contractual obligations.

In the first part of this article, I approach environmental responsibility in agriculture from a perspective in science and technology studies that takes “entering into responsibility” not as an ethical abstraction, but as the result of being actively involved with human and non-human

others (Haraway, 2008: 36). In the second part, I explore how farmers on the prairies got entangled with a handful of multinational corporations through the herbicides and transgenic seeds, that became the basis of their production system. In the third part, I look at the challengers of the master plan of zero-till, the feral proliferation of weeds and volatile molecules. In the fourth part, I analyse how corporations involve farmers into a legitimating discourse and an astralized vision of an intact industrial farming model reassuringly under human control. In the fifth part I explore what it takes to resist herbicides and to become responsive to other humans and non-humans.

1. Corporate Responsibility and Loss of Ability to Respond

In May 2008, I met John Hart again in person at the field where his brother had just stopped the sparkling, up-to-date seeding equipment to get more anhydrous ammonia fertilizer from the tanker truck and fill up the seed tank from the semi parked next to it. They were seeding hybrid Hard Red Spring Wheat of the Clearfield variety Imagine (BASF) that was resistant to the herbicide Adrenaline². The field had been sprayed with glyphosate three days before and now John was seeding into barley stubble with his heavy 425 HP New Holland Tractor, pulling an air drill 54ft wide, the seed tank and the anhydrous cistern. While we were seeding his 150 hectare wheat field, he told me how much he enjoys being out in the late afternoon when the sun bathes the field. This is the moment, when the wind calms down, and it is a perfect moment to spray. Since he was no longer tilling the field, he told me, the soil was less compacted, retained moisture much better, and he could find earthworms in it. This was proof for him, that herbicides were innocuous for the organisms of the soil and healthier for the soil structure, than tilling the field. John was convinced, that he was doing good for the

² The herbicide resistance allowed him an unusual crop rotation. He planted wheat where he produced barley the preceding year and sprayed the barley volunteers out of the wheat crop.

environment, for society and for himself; and he felt in sync with the corporations, that promoted the technology of zero till.

His enthusiasm for herbicide resistant crops jars strikingly, however, with the media storm surrounding the US court cases identifying Bayer/Monsanto's liability for cancer caused by their glyphosate-based herbicide Roundup. The shares of Bayer/Monsanto plunged by ten percent since the company lost three trials in the first instance (US Right to Know 2019) for covering up evidence, that its herbicide causes cancer. The huge settlements, attributed to the plaintiffs in the first instance received considerable global media attention, with thousands more cases pending. The trial highlighted, among other evidence, the 2015 conclusion of the World Health Organization's cancer agency classifying glyphosate as "probably carcinogenic to humans" (IARC 2015). This conclusion was contested by the US Environmental Protection Agency in line with the Bayer Corporation, that decided to appeal the legal verdict. On the other side of the Atlantic, hundreds of thousand European consumers (France Info 2019) concerned about their health and well-being signed a petition to the European Commission (Initiative citoyenne européenne 2017) urging it to forbid the use of glyphosate. This caused an intense debate in the European Commission on the acceptable thresholds for residues of glyphosate and its metabolites.

Glyphosate is the number one weed-killer, the most common herbicide in the world. It was patented and branded as the herbicide Roundup by Monsanto in 1974. Its patent expired in 2000. Over 8.6 billion kilograms of glyphosate have been used worldwide since the 1970s (Benbrook 2016). In 2014, farmers worldwide sprayed enough glyphosate to apply on average half a kilogram/ha on all cropland. Half a kilogram used to be enough in the 1990s to control all vegetation in a one-hectare field. Today however some farmers apply up to seven

kilograms of glyphosate per hectare like on Argentinian soy fields. The substance is now mostly produced in China, which exports 40% of all glyphosate in use worldwide. Since the patent expired, the price has declined and glyphosate has become cheap. It is used on assorted crops that have been bred and were genetically engineered to become resistant to the herbicide so that it can be sprayed in-crop without affecting the emerging small crop plants. In Canada 8,4 million hectares of herbicide resistant canola were planted in 2019, 2,3 million hectares of soy, and 1,5 million hectares of corn. Herbicide resistance has become the lynchpin of the technological revolution of zero-till for large-scale farming first in the US and Canada and now also in Europe. The agrochemical company Monsanto recently bought by Bayer has developed and patented several crop varieties genetically modified to become resistant to glyphosate of which especially canola is dominating Canadian prairie agriculture. Globally, glyphosate use has risen almost 15-fold since so-called “Roundup Ready,” genetically engineered glyphosate-tolerant crops were introduced in 1996 (Benbrook 2016), and sales are projected to rise by a further 25% until 2024 (Mordor Intelligence, 2020). US American farmers sprayed 290 million pounds of glyphosate on their crops in 2016, according to U.S. Geological Survey data. That amounts to nearly a pound of glyphosate for every person in the country (Pesticide National Synthesis Project, 2018).

The molecule glyphosate was a prominent target in the International Monsanto Tribunal (n.d.) set up by civil society organisations from all over the world in 2016 – 2017 accusing the multinational corporation of ecocide and of disrespect for the UN Guiding Principles defining corporate responsibility to protect and respect Human Rights (endorsed in 2011). Witnesses at the tribunal denounced the failure of Monsanto to acknowledge birth-defects, kidney-failure and Non-Hodgkin lymphoma as a consequence of glyphosate spraying, Their voices resonate with Rachel Carson's (1962) struggle against DDT fifty years earlier when she evoked the

responsibility of the military-industrial complex for disguising toxicity both physically and rhetorically (Nixon 2011, xi) and with Steven Druker's account of how the U.S. Food and Drug Administration (FDA) was responsible for allowing genetically engineered crops onto the market without the safety testing that is required by federal statute (Druker 2015).

The principle of responsibility, as the philosopher Hans Jonas formulated it, is the foundation of an environmental ethics that affirms the moral imperative that humans have to restrain their actions, so that they don't destroy the possibilities for future generations: "Act so that the effects of your action are compatible with the permanence of genuine human life on earth."³ (Jonas 1984: 36) This understanding of responsibility recognizes other organisms as active agents, self-feeling subjects, purposively concerned with themselves and their very being (Donnelley 2002: 40). Jonas postulates the value and dignity of all beings in nature and calls for care and respect for all life on Earth. In effect, global commerce and migration produce ecological flows of microbes, proteins and minerals linking the open porous and susceptible system of the living soil in the Canadian prairies to the guts of distant consumers, some as far as China, Africa and the European Union. Soil organisms recreating collectively the soil ecosystem, nourish the plants that grow and ultimately the humans and animals who feed on them. Newly mapped microbiomes show that the sheer number of microbes that inhabit human and animal bodies including bacteria, viruses, protists or parasites exceeds the number of bodily cells by a hundredfold (Åsberg 2017). Bodies and living soils are sympoetic (Haraway 2016) "collectively producing systems that do not have self-defined spatial or temporal boundaries. Information and control are distributed among components. The systems are evolutionary and have the potential for surprising change." (Dempster 1998, 27-32) They respond to the chemical treatments, that human give them in multifarious ways. A morally

³ „Handle so, dass die Wirkungen deiner Handlung verträglich sind mit der Permanenz *echten* menschlichen Lebens auf Erden.“

responsible human life thus implies moderation and precaution in acquiring and using the power of technology and wealth when interacting with other forms of life on earth (Jonas 1984). The care for the soils in the Canadian prairies also affects the health of farm animals, some far-away in China fed with canola meal from Canada, others relatively close, raised in feedlots in Alberta or in pigs factories in southern Manitoba. How do large industrial farmers respond to that muddle, can they care about faraway consumers and farm animals?

Jonas' environmental ethics stands in striking contrast to what Robert Zimdahl following Paul Thompson (1995) calls unsympathetically the one dominant ethic of agriculture: "there is only one imperative—to produce as much as possible, regardless of the environmental/ecological costs, and perhaps even if it is not profitable to the producer" (Zimdahl 2006: 218). Large grain farmers in Saskatchewan embrace this moral imperative by legitimating their work as "feeding the world". The nature of this imperative is challenged, however, when farmers stuck with heavy debt loads try to increase production even further. Jan Douwe van de Ploeg sees a peasant ethic of agriculture re-emerge among what he calls "entrepreneurial farmers" (van de Ploeg 2009: 138). When they begin to lose money, some farmers become able to perceive the limits of a moral economy of the market, where "[o]nly a few will win". They begin to doubt their "fast and rough" farming style (van de Ploeg 2009: 140-141) that is costly and damaging to the land. In response big agricultural corporations initiated elaborate promotion campaigns, to uphold the dominant ethics of agriculture and to counter the awareness, that instead of feeding the world, "we are feeding in essence a lot of big corporations" as one farmer I interviewed put it. (Müller 2008, 402).

When cultivating their fields, farmers mobilize more than abstract moral principles as they interact with other forms of life. Their responsibility builds on response. They have to be able

to respond — be "response-able" — in daily practice to the myriads of "fibrous entities, flagellated beings, myofibril braids, swelling roots, reaching and climbing tendrilled ones" (Haraway 2016: 32) that intra-act to make the soil eco-system. My take on this "responsibility" thus goes beyond ethical principles and builds on experience, that "recognizes in its primary integrity no division between act and material, subject and object, but contains them both in an unanalyzed totality" (Dewey 1925: 8). Response-ability is a multidirectional relationship between farmers, plants, bacteria, fungi, insects that implies the ability and capability to respond in practice. "Organisms are soil. A lively soil can only exist with and through a multispecies community of biota that makes it." (Puig de la Bellacasa 2015:11) Soil is partly organisms, but also partly inorganic, the living interface between the biosphere and the lithosphere. Farmers feel the dire consequences if they don't attend appropriately to the needs of their soils' communities. How do farmers know, and do they want to know, about the consequences of their practices for their closest "companion species", the myriad of organisms in and of the soils they farm?

2. Glyphosate the Golden Bullet: enthusiasm

The broad-spectrum herbicide glyphosate together with the development of herbicide resistant varieties was instrumental for nothing less than a technological revolution in cultivation techniques. It allowed chemicals to replace the plough — and in North America where ploughing has been greatly reduced since the disastrous consequences of the Dust Bowl in the 1930s — it replaced the cultivator with broad shovels by disk openers or seed drills with opening knives capable of placing the seed exactly at the desired soil depth without disturbing the soil structure. The role of tractors has significantly diminished in this type of farming, as they are now needed mainly for pulling the seeding implements. The main money-maker,

canola, the Green gold of the prairies, was developed in the 1970s by public breeding institutions. They made rapeseed useable for the food and feed industry by breeding for low erucic acid content and a low level of glucosinolates (Brewin and Malla 2012: 258). The public institutions then licenced canola to private companies that engineered canola plants to become resistant to herbicides. Herbicide tolerant canola comes in three versions resistant to three different herbicides.⁴ As it is fast and easy to grow, canola hectares increased from less than a half million ha in 1968 to more than 9,3 million ha in 2018; from less than 5% of crop land in Canada to over 25%. According to the agricultural census of 2016, canola covers now as much cropland as wheat and durum together (Statistics Canada 2017, 6). 90 percent of the canola in the form of grains, oil and oilcake is exported predominantly to China and Japan.⁵ Since more and more herbicides were sprayed in-crop during the growing season, farmers bought their own 40 metre large high clearance sprayers, that allowed them to spray without damaging the ripening crop. The seeding implement, the sprayer and the large combine with straight cut-table represent an investment of almost two million dollars, if bought new. However, some farmers feel enthusiastic about the technology and confident about the high financial risks they were taking.

In early June 2008, the fields stretching to the horizon covered with dry stalks and timidly emerging tiny weeds, I went on a crop tour with Bob Sand one of the few younger farmers I met in Saskatchewan. Bob farmed a thousand hectares, inherited from his dad and bought

4 The three herbicide tolerant (HT) weed control systems in canola are: Clearfield - canola resistant to imidazolinone chemistry (Odyssey, Absolute, Solo, Ares, Tensile) Liberty Link - canola resistant to glufosinate ammonium, a naturally occurring broad-spectrum systemic herbicide produced by several species of *Streptomyces* soil bacteria (Liberty), Roundup Ready - canola resistant to glyphosate. [<https://www.canolacouncil.org/canola-encyclopedia/weeds/weed-management/>] Genetically engineered Herbicide-tolerant crops now account for about 56 % of global glyphosate use (Benbrook 2016).

⁵ [<https://www.canolacouncil.org/markets-stats/market-access/>] Prices of canola seeds, oil and meal increased tremendously during the 2000s. Growing canola has been consistently more profitable than growing wheat, until 2018 when the high input prices for canola made growing it less profitable than growing wheat. [<https://www.canolacouncil.org/markets-stats/statistics/current-canola-oil,-meal,-and-seed-prices/>]

with money earned with custom spraying for other farmers. He showed me his new airseeder modified for zero-till by replacing the cultivator shovels with disk openers. The disk openers were two round blades, that stood in a five-degree angle to one another, the second disk lightly offset from the first one. The disks are able to cut into the soil almost without disturbing it maintaining the cover of stubble and the residues that lay on top of it. Pulling the disker with the tractor used half as much fuel, as pulling a seeder with cultivator shovels. The rotary blades cut, the seed fell in behind and a packer wheel closed the furrow. The day after seeding, before the crop emerged, Bob sprayed glyphosate. He told me, the system was perfect. Directly seeding into stubble or even weeds, the earth crust was kept intact, the moisture was conserved, because it was not exposed to evaporation. "Moisture is the most important element for farming in the prairies," he explained. For that reason, he let the straw of wheat and oats stand as long as possible to collect snow in the winter. The residue also contributed to building up organic matter. That day he was seeding peas into the stubble. They would be climbing up on the straw, which prevented them from lying on the ground, when ripening. At harvest, they could thus be swathed more easily. Bob read an article, which said that in a zero till plot three hundred earthworms live on one square meter. The earthworm tunnels were lined by nitrifying bacteria and thousands of microorganisms co-operated. Going through this system with a shovel destroyed it.

Bob was fond of the technology because direct seeding was less work and saved a considerable amount of fuel. He had applied glyphosate on his wheat field in the fall just before harvesting, which killed and dried the wheat plants and the weeds emerging under its canopy.⁶ He explained:

⁶ Unlike the regulations in the EU and certain US States there are no restrictions or time limits set in Saskatchewan how many days previous to harvest a farmer could still spray glyphosate on the ripening crop. A Maximum Residue Limit (MRL) is set by Health Canada's Pest Management Regulatory Agency (PMRA), which can differ from the MRLs of importing countries. (Saskatchewan Ministry of Agriculture

That's what the preharvest Roundup does for me, it dries down the crop and I can straight combine these 500 acres. It's much quicker to spray it, than it is to swath, and it sets me up for next year for the weeds - I don't have all these weed problems. And this is what continuous cropping is all about, keeping everything under your thumb and having control of everything. (Conversation 11 June 2008)

He then harvested the crop leaving as much stubble as possible. Now in June, few weeds could be seen in the field. Just before the pea plants emerged he would give it another application of glyphosate to kill all the emerging weeds and provide the crop plants with an advantage. As the glyphosate patent had expired, applications cost him only about twelve dollars per hectare while other herbicides, that can be applied to the standing crop, were five times more expensive, sixty-two dollars a hectare. He explained: "Glyphosate is less toxic and decomposes as soon as it gets into contact with the soil."

Bob told me again and again, how much his farming technics have changed since 1994, when he started farming. He was no longer tilling the fields every two to three years to let them lie fallow over the summer. He could farm more land in less time, burned less fuel, prevented erosion, conserved moisture and built up organic matter. He told me that his attitude to work was evolving differently too to the one of his father and grandfather. His grandfather knew nothing but work, his father started to appreciate to have more free time and move around, but he himself had come to travel and to appreciate his hobbies. He liked his work, but he still preferred not to work and have more free time to go fishing, scuba-diving, flying ultra-light

2019, 10) A shipload of wheat, for instance, will excess levels of glyphosate residue could be refused at port if detected.

aeroplanes and spending time with the kids. His work was no longer all there was. He wanted to take off and see the world.

Bob showed me winter-wheat stubble on which he had applied another selective herbicide, Edge (Gowan), in a surface application in the fall to prevent the germination of the weeds and then disked granular nitrogen in. Under the stubble he showed me how the moisture was conserved and the weeds that were coming up. He found little Wild Oats (*Avena sativa*) seeds, which had not germinated. He wanted to seed mustard here and will apply glyphosate pre-emergence a few days after seeding to kill the remaining weeds, so that the mustard can get ahead and out-compete them. He showed me Flix Weed (*Descurainia sophia*), Wild Oats and Stink Weed (*Thlaspi arvense*) coming. It took him four to five years of zero till until the annual weeds were controlled. They only emerge if they are disturbed, covered with soil. He showed me — making grand gestures — how all is a question of who gets ahead of the other. “With the glyphosate Roundup you kill the weeds that grew before the crop emerged and would have covered the small plants up. The small crop plants can thus emerge virtually without competitors”. They can profit from the moisture conserved under the straw, get the nitrogen, he has put in, and profit from the organic matter, that he has conserved and left undisturbed: “as good a job as it gets”.

The zero till system does not compose, however, with the agency and intentionality of non-human actors: plants called weeds, fungi, soil particles and even the molecule glyphosate itself. When I visited Bob again, five years later, he had changed his cropping pattern to alternate between flax and oats because his wheat was badly impacted by fusarium head blight and his canola by sclerotinia, both fungal diseases. On the crop-tour in July 2013, Bob was conflicted in spite of his confidence in the model: enthusiastic about the flexibility that

the herbicide resistant canola allowed him and concerned about the widespread infection of his crop with fungi. He blamed himself for not having applied sufficiently strong fungicides. What did he see and know and how did he decide what to do? Bob constantly pointed to the fact that his knowledge had evolved and that he would have told me – probably with the same enthusiasm – a totally different story about his technological choices ten years ago. This seems to confirm Tim Ingold's (2000) claim that a farmer regrows his skill each time he farms. However, his contrasting attitudes about technology and chemicals suggest that he was not only 'regrowing' his knowledge, he also received it in large measure, from agrochemical companies and their extension officers. Bob entered into an active engagement with his soils and crops, and based his agronomic decisions partly on his experience. However, when he could have questioned the consequences of the massive use of glyphosate, he demoted to the authority of expert opinions, that did not put his farming model into question.

An abundant scientific literature mostly published by public researchers (Fernandez et al., 2009, Duke et al., 2013) shows the link between the excessive use of glyphosate and the explosion of fungal diseases. The action of glyphosate transforms the composition of microorganisms in the soil and prevents the uptake of essential trace minerals by the plants. Glyphosate remnants have been detected in a large variety of food items and links have been established between the exposure to glyphosate, cancer and increasing male sterility (Clair et al., 2012). These findings, which were at first only used by anti-GM activists and organic farmers, received in 2015 support from the International Agency for Research on Cancer of the World Health Organization (2015) and led in 2018 to the spectacular glyphosate trials in California. Pro-GM scientists however, still brand them as ideological and without scientific validity. They produced an equally abundant literature advocating direct seeding, herbicide resistant GM crops and the use of herbicides, as a means of combating erosion, maintaining

the soil structure (Cerqueira and Duke 2006) and fixing carbon. In their press communications, Bayer points to more than a thousand studies, that endorsed glyphosate as innocuous. This latter scientific paradigm has huge financial interests attached to it and is promoted by all major agrochemical corporations and most agricultural technicians — an oligopoly of only four companies controlling in 2019 84 percent of the global market for agrochemicals.⁷

These two paradigms confronted each other thus unequally in the field of the farmer. I asked Bob, whether he saw a link between the use of glyphosate and zero till and the fungal diseases fusarium and sclerotinia. He thought, that there was no such link, and that the claim was unscientific and scare mongering. He maintained, that glyphosate dissolved very quickly in the soil and was basically “a salt”. Bob did not take notice of any critical analysis of the effect of glyphosate that would have put into question his entire farming model of direct seeding. Although he still had an intimate knowledge of his plants, weeds and soils, (which many farmers have progressively lost to agricultural consultants), he did not consider the potentially noxious effect of the wide-spectrum herbicide. Also, he fundamentally trusted information coming from the most successful private corporations. His rationale was: a technology would not survive market selection, if it were not sound. Only the best survived on the market. He had intimate knowledge of his crop and soils, but the direction of his choice was determined by his being-in-a-world of high technology and market powers, impervious to the rational weighing of scientific choices. As addiction anthropologist Natasha Dow Schüll (2012), has shown, technologies from gambling machines to smartphones, are often designed explicitly with addictogenesis in mind. They serve as a means of restructuring the turmoil-afflicted mind with goals and direction, alleviating stress and anxiety and creating the illusion

⁷ Bayer-Monsanto 27,4%, Syngenta-ChemChina 26,9%, DuPont-Dow Agrosiences 16,8% and BASF 12,9% (ETC Group 2018)

of control. As cycles of technological innovation are moving faster and faster, dramatic changes in terms of agronomy are taking place in relatively short periods of time, thereby reducing the autonomy and agency for farmers, once they decided to purchase their seeds every year, to apply ever-higher levels of chemicals and fertilizers, while paying back debts on multimillion dollar machinery.

3. Feral Proliferation and Chemical Overrides

Farmers' love for clean homogeneous fields is a systemic imperative linked to the fundamental search for increased labour productivity and yield. Biological simplification and standardization are pivotal to the pursuit of scale, but they also create conditions that other species can take advantage of. Bob told me, that glyphosate did not “get” cleavers (*galium aparine*) and kochia (*bassia scoparia*). As weeds become resistant to glyphosate, they take advantage of their privileged position with respect to other weeds and fill the space left by them. Kochia has become such a weed in Saskatchewan. The seeds of glyphosate resistant weeds are carried by the wind from field to field and spread. It is just a question of time when glyphosate will become ineffective as a broad-spectrum herbicide. Bob followed agronomic advice, when he mixed Authority (FMC Corporation), a highly toxic Sulfentrazone herbicide together with glyphosate in the same tank. He showed me the spots in his flax field, where he missed a spot, and where cleaver and kochia thrived. He also sprayed the slues to avoid the spreading of weeds from there.

The ideal weather for spraying is a sunny wind-still day, so that the herbicide cannot drift unto the neighbours' fields and yards and destroy the wrong plants. Many farmers however are in a hurry to get all their crops sprayed. On many windy days, when I hoped to visit with

farmers, they were in fact out spraying. The view of the weeds growing inside the crops seemed to put them into a state of near panic. The effect of a plugged-up sprayer-nozzle can be seen in the homogeneous fields from afar, because weeds stand out in different colour and size. Farmers hate it, when neighbours and passers-by notice and comment on it. Bob's neighbour, Thomas, wondered how he could ever grow a crop without herbicides. Even his flax on summer fallow, that looked beautiful just days before, was overwhelmed by weeds. Around the yard, wild mustard was omnipresent and it had been there since he bought the farm that had now 2000 hectares. It came back every year in spite of all the herbicide applications. The seeds of wild oats are viable for 15-20 years. Members of the grass family, they came with the settlers and their crop seeds from Scotland and are now stored in the soil. When disturbed, they come up and grow. Canada thistle, (*Cirsium arvense*) is a perennial species of flowering plant, native throughout Europe, that is classified as a noxious weed in Canada. Organic farmers have the greatest difficulty of dealing with. Its root system spreads underground and over the ground dispersing amazing amounts of seeds. One of the methods of controlling it, is pre-harvest burn-off. Thomas does not want to spray herbicide on the ripening crop, though, as it will definitely enter the food chain. He tries to spray Canada thistle on summer fallow in August, when the plants bring down nutrients to the roots together with the glyphosate, that will kill them. But two years later, thistles are back, thick as ever.

Glyphosate is like an entry drug to chemical dependency. The sheer volume used and the fact that glyphosate molecules bind with the soil and subsist over long periods of time, makes it a hazardous chemical in the medium term. Driven by the growing diversity of uses and dramatic increases in volumes applied, levels of glyphosate and its metabolites have been detected in the air, soil, and water. In countries like Canada, that authorize the cultivation of glyphosate resistant plants, spraying becomes indiscriminate, the surfactant holds the

molecule down on the plant, glyphosate gets into all the parts of the crop and weeds learn to resist. The efficiency of the molecule glyphosate “to kill” all plants makes consumers think that glyphosate is the most toxic of agrochemicals. In comparative doses, however, glyphosate may be one of the least toxic herbicides. Its effect on the plant is not by contact but by systemic action. Sprayed on the leaves it is absorbed by the entire plant, brought from the leaves to the root system. It interferes with soil bacteria, which explains why a 2010 patent on the molecule was also for its effect as an antibiotic. It disturbs the equilibrium between fungi populations — another patent claim on glyphosate concerns its potential to reduce the fungal plant disease rust. Glyphosate does not leech easily, because the molecule and its primary metabolite aminomethylphosphonic acid (AMPA) binds with soil molecules and persists in the soil (Helander, Saloniemi, & Saikkonen 2012). Recent studies demonstrated, that 10 to 60 % of glyphosate subsist especially in cold climates and can still be detected in the soil after one year. Like most herbicides, glyphosate breaks down into salt metabolites. However, when these salt molecules attach to natural aerosols, as they are photo degraded, washed out, settled out or landed out, they are of a high volatility and can move into the atmosphere. These salts can then be found in remote places like the polar caps (Chang, Simcik, Capel 2011). Anna Tsing calls this out-of-control reproduction of invasive species and volatile substances “feral proliferation” (Tsing 2015). It needs human intervention to get started and thrives with monocultures.

Plants are able to adapt to environmental pressure. Regular spraying at determined moments in the year becomes such a pressure, to which the plants react by sprouting later in the year, or setting seed outside the windows of spraying. Anthropologist Natasha Myers picked the brains of plant scientists for explanations and found out that plants “keep time” using complex networks of interacting genes and proteins, that are conceived as “internal timers”. "These

circadian clocks are sensitive to changing environmental signals, such as shifts in the number of hours of daylight over the course of a year, or the varying amounts of heat and cold, or humidity and dryness of each season" (Myers 2015, 44). Philosopher Michael Marder speculates: "Whereas humans remember whatever has phenomenally appeared in the light, plants keep the memory of light itself" (Marder 2013, 127). He defines plants' rumination as "thinking before thinking"—that is "nonconscious intentionality" (Marder 2013, 125) that "fuses with milieu" and does not have to return to the self. Plant geneticists Karpinski and Szechynska-Hebda explain that plants are able to perform biological quantum computation and memorize light in order to optimize their Darwinian fitness (Karpinski & Szechynska-Hebda, 2010, 1391). Plants grow tolerant to difficult conditions such as excessive or inadequate light, water, salt and temperature, and resistant to pathogens. Not only is plant physiology known to change under stress, but changes in the genome have also been identified (Molinier et al., 2006).

Thomas was no fan of glyphosate. He used 2,4-D on the wheat "to take care" of broad leaf weeds and Achieve/24D mix (Syngenta) against wild oats. On another field, where wheat competed with thistle, he applied the herbicide Curtail (Dow). None of the common herbicides effected round-leaf mallow (*Malva pusilla*), native to temperate and Mediterranean Europe, Turkey, Caucasia, and northwest Iran, that that grew in the field around the yard. He just left it. It liked rich soils. On the flax, he used Curtail against broad leaf weed and thistle. Its active ingredient Clopyralid enters treated vegetation through the leaves and roots, and replaces natural auxins at binding sites, causing abnormal growth patterns and disrupting the growth processes of the plant. It is toxic to some beneficial insects like the ladybug and lacewings.

As weeds started to become resistant to the herbicides used on canola, the three competing corporations at the time⁸ agreed to develop varieties that “stack” the three resistance genes. They can thus be sprayed, if necessary, with all the three herbicides “layered” one on top of the other. However, superweeds have emerged able to survive even this concerted chemical attack. Jason Moore (2012, 226) stressed the Super Weed Effect as a way in which non-human natures overtake human abilities to control. Tony Weis speaks of perpetual biophysical “overrides” that are built into the industrial agricultural system to repeatedly respond to problems produced or exacerbated by the pursuit of scale (and the associated biological simplification and standardization noted earlier). “The chemical fix for industrial agriculture has routinely led to a treadmill of dependence as resistance develops, natural controls diminish and more or new inputs are applied.” (Weis 2010, 320) Biophysical overrides are continually responding to, but never resolving, the root problem in ways that mask and /or deepen old problems and establish new risks.

One such risk is farmers returning to highly toxic older herbicides. Monsanto and Du Pont obtained authorisation in Canada to commercialise seeds genetically engineered to resist glyphosate and the older herbicides Dicamba and 2,4-D. Dicamba herbicide has been banned in many countries because it is highly volatile. If the weather is right, often in early morning a cloud of Dicamba herbicide may lift up from a sprayed field and travel several hundred meters to come down on another field destroying the entire crop. Many of the new herbicide brands on offer are in fact recompositions of old chemicals such as 2,4-D. Landmaster (Monsanto) Statesman, Crossbow, Curtail (Dow) Trimec (Bayer) — to name just a few — all contain among other components 2,4 D. It is one of the oldest and most widely available

⁸ Monsanto owned the RoundupReady trait, Bayer Crop Science the LibertyLink trait, and BASF the Clearfield trait. As a condition for authorizing the mega-merger between Monsanto and Bayer in 2018, Bayer had to sell the Liberty Link technology to BASF.

herbicides in the world, having been commercially available since 1945, and is now produced by many chemical companies since the patent on it has long since expired. 2,4-D is one of the ingredients in Agent Orange, a herbicide that was widely used during the Vietnam War. Other herbicide brands in use contain the component Paraquat, that is highly toxic and causes respiratory illnesses, MCPA with the Chlorophenoxy compound categorized as highly toxic, Bromoxynil, Triallate acutely toxic, Trifluralin... (Saskatchewan Ministry of Agriculture 2019)

4. The Banality of Intoxication: A view from the Sky

The chemical overrides confirm Adornos' dictum: the promises of development that modernity gives us, offer false alternatives. (Adorno 1973) However false these (chemical) alternatives may be, they are potent, as they offer excuses for not pursuing critical thinking, where it would put into question fundamental life style choices and engrained practices. These chemicals have a pivotal role in shaping biologically simplified landscapes on a massive scale, with complex reverberations. Similar to discourses denying climate change, that have been embraced, financed and sometimes even written up by the fossil fuel industry, studies financed by the chemical industry emphasize the harmlessness of glyphosate and are happily endorsed by large industrial farmers like John Hart and Bob Sand and corporate sponsored farm lobby groups like the Western Canadian Wheat Growers. This small group of big farmers spreads the message that “farmers have been on the cutting edge of environmental protection through the continual adoption of modern agriculture farming techniques. [...] Farmers maintain a climate balance through the high levels of carbon-sequestering used in the production of sustainable, high-quality food used both domestically and exported internationally.”(Western Canadian Wheat Growers, 2019) “The forces of inaction have deep

pockets”, as Rob Nixon observed considering the climate change debate (Nixon 2011, 39). He sees “a lavishly funded army of new bewildereders” at work, “doubt producers and doubt disseminators whose job it is to maintain populist levels of uncertainty sufficient to guarantee inaction” (Nixon 2011, 40).

But also government representatives in search for easy solutions to climate change like the former French agriculture minister Le Foll tune in with this concert of voices from the chemical industry. When I attended in 2015 the Global Landscape Forum in Paris parallel to the COP21, the argument went: If all agricultural soils in the world would fix an additional 4/1000 of soil carbon, the problem of global warming would be solved. Tillage, on the other hand, had to be reduced, as it provoked soil erosion, released CO₂ and methane from the soil and would compromise the carbon fixing mitigation strategy. The promise of zero-till practices accompanies the emergence of a highly speculative climatic regime, that draws on expectations that technological development will make it possible to anticipate, mitigate, and adapt to climate change after previous attempts to decrease anthropogenic greenhouse gas emissions have stalled (Granjou a.o., 2018).

Promoters of zero-till systems use sponsorships and new media to convince producers that zero-till agriculture represents their best option (Gertler, Jaffe, Beckie, 2018, 169). Proponents of agricultural biotechnology, machine companies eager to sell a new generation of equipment, university researchers needing funding from corporate sponsors adopted and endorsed new language, such as “precision farming”, “sustainable intensification” and “climate-smart agriculture” to promote these practices. As big industrial farmers feel increasingly under attack from media, environmental activists and consumers, who accuse them of intoxicating their food, killing pollinator populations and destroying the soil, they are

told by corporate sponsored networks, such as Licence-to-Farm (licencetofarm.com), The-Real-Dirt-on-Farming (realdirtonfarming.ca) and Agriculture-More-than-Ever (agmorethanever.ca), that they have “to talk back to the consumer”.⁹ What the promoters mean by “talking-back” can be seen in a video clip produced by Agriculture-More-than-Ever (2016). A charming farm girl nursing a lamb, a teenage farm boy in front of a 4H Board, a young farmer next to a farm shed affirm: “Somebody should speak up!”– “Somebody should set the record straight!”– “Somebody should do something!”– “Well I am somebody” – “I am somebody!” The video strikingly devoid of content only insinuates that it is the record of farming that should be set straight. It also implies, that it is farmers as persons who are unjustly ignored and under attack. Mobilizing the paradigm of identity, rather than economic interest, contrasting with habitual farmers’ complaints about low crop prices and bad weather, it deliberately uses positive upbeat language. Resonating with the language of new nationalist/patriotic movements, the website encourages to come out as farmers and to stand up for the technologies they use and through this, to stand in the way of public fears and criticisms about these technologies. After farmers have spoken, a representative of Bayer in front of a big Bayer CropScience logo tunes in as “somebody who speaks from a place of experience with passion and conviction”.

The company is candid about the strategy of playing with the pride of farmers enrolling them as promoters for their technologies. In a video from the 2017 Bayer sponsored AGvocating Conference, David Hollinrake from Bayer CropScience (2017) explained:

⁹ The idea of using social media to improve the image of farming among the general public was conceived in 2009 by a group of farmers and ranchers in the US who felt upset about the bad press that meat and dairy farmers received after a series of articles about cruelty against cows on dairy farms, feedlots and slaughterhouses

We have done the research and we know that consumers trust farmers more than us, more than scientists, more than folks, that work in the university, more than the government, more than nutritionists. It is really critical, that we arm farmers with the right information. But it is not just the information; it is also the style by which they need to connect with folks, that may not have the right information. What we have done, is create a AGvocate training program, and we have so far trained over 1000 people involved in agriculture outside of Bayer. (Bayer CropScience 2017)

This advertisement strategy goes far beyond the distribution of caps and t-shirt with corporate logos, that chemical companies used for promotion in the past. Industrial farmers are enlisted with their full consent to spread the corporate message that agricultural biotechnologies and the associated agrochemicals are indispensable for feeding the world. Critics of industrial farming and consumers concerned about the quality of their food — so the message goes — are simply ill-informed and ignorant, because they have lost touch with the realities of modern farming. Hollinrake continued :

The fact that folks are not involved in how their food is grown any more, really creates that divide, and frankly a misunderstanding of the *tools, that create* the food on their table. Most of the folks that are opposed, don't go to bed hungry every day. But the simple fact is: We have 800 million people in the world going to bed hungry every day, and millions, tens of millions within our borders in the United States. So it is not just important that we produce more, but that we showcase the fact; that we are doing it in a responsible way. (Bayer CropScience 2017, my italics)

In a bout of hubris the corporate representative goes as far as to claim that it is “tools that create” the food on the table. Natural processes, plants, soils and even humans are secondary to the creative power of technology. He does not specify though, what agricultural practices he actually means, when he talks about producing “in a responsible way”.

The message of AGvocracy has been picked up. Over the past years, several large grain farmers in Saskatchewan have produced 20 to 30 minute-long films following their farming operation through the seasons, and they posted the films on the internet. Some of these films have become extremely popular and were watched worldwide by spectators fascinated by high-tech farming: the film on the seven thousand hectares Jason LeBlanc farm (Zinchuk, 2017) in Estevan SK has been watched 514 680 times and its Youtube channel has 3100 followers. The video of the three thousand hectares Keith Farms (2018) received 626 456 views since it was posted on the 21 March 2018. Viewers from all over the world — Bulgaria, France, Argentina, Ukraine — marvel at gigantic machines, the grain bags and the crop duster plane, disregarding the role that these technologies have played in the sharp decline in the actual population of farmers. The films show the immense flat prairies of Southern Saskatchewan, where all treed shelter belts have been removed, focus on the towering cloud formations, show men at work joking and laughing, while they fill the seed and chemical reservoirs, waving happily from their computer geared equipment. They follow the giant agricultural equipment through the seasons mostly filmed with drones, that show the intricate patterns drawn by the moving machines in the glowing evening light, in the crisp spring morning, the bright light of noon. The pictures are underlain with country music. When the crop duster plane takes off from the Keith family farm, the film-song evokes the little town, the family, the memories, the deep roots and the mud on the boots: “Plaid dirt, white shirts, blue collar roots still runnin' through my veins... I would not change a thing...” The Keith

family is among the proud winners in the race for farmland in Saskatchewan. Since 1996 the number of farm operators of both sexes in the province has declined from 72,925 to 45,350 in 2016. (Statistics Canada, 2020)

The films seem to follow a pattern recommended in a 2014 webinar on the website *Agriculture-More-Than-Ever* by the consultant Andrew Campbell¹⁰, himself a dairy and grain farmer in southern Ontario. In his webinar he explains to his fellow farmers “how to get in on the tough ag and food conversations” (Campbell 2014) about animal cruelty, gluten intolerance, chemical use, GMOs. He tells them:

For the consumer facts do not matter. What convinces the consumers, are not the facts themselves, but the perception of the facts. [...] Activists are skilled at playing with emotions, ‘knock at the heart’, ‘wrench the gut’ of the consumer. They appeal to the fear of the unknown in their campaigns against GMOs, against chemicals, against everything synthetic. (Campbell 2014)

Campbell recommends, the most effective way to counter the slow erosion of consumer trust is to counter these negative messages with positive ones, to give the consumer the message they want, inspire awe, laughter, amusement. Farmers should avoid “the lingo” of the agriculture industry and educate the consumer without them even noticing, through pictures and simple language: “talk from your own experience, bring back the family element, bring that connection the consumer can relate to, of people working hard and bringing up a family. Make sure that people can see your face so that they can build trust.”

¹⁰ Campbell has his own website called Fresh Air Media.

The videos offer mostly a view from the sky on the farm as a smooth-running system perfectly under human control. Weeds, crop disease, hail damage, invading swarms of snow geese or even machine breakdowns don't figure in these films. The spectator sees the crop as a mass, clean, in straight lines or as a flow of grain pouring from the combine into the truck. The spectacles evoke “the moral goodness of routinized work in orderly fields and villages”. (Li 1999). The farmers have no qualms of showing in their videos pours of seeds covered with chemicals, tainted in blue, flowing into the grain auger. The internet public is clearly awed by the spectacle of grandeur and human mastery as one can see from the comments posted. The evocation of order and control in a mix of romantic family values creates sentiment, which resonates with a genuine nostalgia for the uncontested modernist dream. Anti-GM activists don't seem to watch these movies as they get mostly thumbs up from their international audience. Of course links to these types of videos get circulated disproportionately amongst inclined communities via people forwarding links, liking them on social media. Through algorithms people get drawn to subjects they've already evidently liked. The relative success on the internet thus does not mean, that Bayer's strategy of AGvocation was successful and that the videos swayed the opinions of concerned consumers. What they did reinforce, however, was the sworn community of big high-tech farmers.

5. Resisting Herbicides

Most Saskatchewan farmers I talked to back on the ground, however, are ambivalent about the modernist dream of increasing size, speed and control. They regret the weakening of rural communities, the depopulation of the countryside, observe the aging of the farming population. Once farmers retire or sell out and families leave their farm sites, these are transformed: fields are consolidated, houses and farm sheds pulled down, trees and hedges

ripped out. Sometimes a small signpost remains to remember the farm-site or the local schoolhouse. At the Smith Farm where four generations have been involved in farming, grandfather Harold, 82-year-old, was opposed to zero till and had practiced mixed farming almost all his life. Until the 1990s he and his wife Edna had raised hogs housing an average of 35 sows at a time, milked twelve cows, kept chicken and turkeys and sold eggs and cultivated wheat and barley using 50:50 summer fallow, leaving the fields lay fallow, bare of vegetation every other year. Harold proudly told me, that the nutrient cycle on their farm had been almost complete, as hog, chicken and cow manure went to fertilize the fields. Spoilt grain was given to the hogs and the chicken would pick up any kernel of grain, that fell to the ground. He and Edna recalled the days, when the local train stopped at their doorstep every day to collect the cream cans and carry them to the local processor. In their lifetime, the branch-lines were closed down, the milk processing plant was transferred from Carlston (10 km away) first to Saskatoon (60 km away) and then to Calgary (600 km away).¹¹ At first it had felt like progress, when they were able to get running water, build a bathroom, and a pig-barn. He was happy, when herbicides came along to help him control the weeds in the crop. "That was a wonderful thing when this came in. It was so cheap. When the crop grew really dirty there was nothing you could do otherwise." Then by 2003, when I interviewed them, they had seen their way of life disappear and be replaced by big farm operations, even bigger than the grain

¹¹ Harold Smith: 'It is interesting to know what happened to the cream. In the early days a truck would come round once a week and pick up the cream We used to have a small ice well outside under some straw where we would keep the cream can cool. The can would be five gallons. Then that changed; the truck would not come any more but as we were just a mile and a half from the railway track. The train would come in every day at noon and switch at Carlston. So we would go along to the track and put a flag on the platform of the station house and the train would see the flag and slow down and pick up your cream.'

Edna Smith: 'After we were married we would not do that any more. We would deliver the cream to Carlston and the big train would take it into Saskatoon and it went into the processor in Saskatoon. It would not be too long and the trains would not pick it up any more. When we would go into the city of Saskatoon we would take our can of cream ourselves. This would have been in the 1980s and then finally they got very strict and if your cream can had a little rust on it, it was condemned. You had to buy a new plastic one. So eventually they would not unload the cream in Saskatoon. We brought it to the city and they would haul it all the way to Calgary, 500 miles away. We never did understand that. It was a dairy pool. It was a farmers' organisation... You had to wait for a week for your empty can to come back. We quit the thing then it became too ridiculous.' (Harold and Edna Smith, farmers in Carlston 4.7.2003)

farm of 800 hectares (2000 acres) that their son Ryan was running with the most modern equipment: “Volume I guess, is what they are trying to get instead of a better crop on a smaller piece of land. His crop is yielding less per acre but he has the volume on his over 2000 acres.” Harold refused to let his son use glyphosate burn-off, though, on the fields he rented to him, but when Ryan took over the farm, he bought him a new combine and an air-drill for direct seeding. The next generation, their grandson, now teaches his father Ryan how to use the board-computer and monitor the fields. Meanwhile, Edna and Harold were watching closely the emergence of a farmers' market in Saskatoon and mused full of hope, that their model of farming might return: “If I was 40 years younger, I would like to try, whether it could still work the way we did it.” — and Edna speculated: “Maybe it is going to break and the small people take over. That’s what I am imagining down the road. But this might take another hundred years.”

Direct selling of the tremendous flows of grain and meat produced in Saskatchewan would be impossible, as the Canadian prairies are still sparsely populated. Harold and Edna were an exception. On their small mixed farm, where they transformed part of their products themselves, they were able to enjoy the compliments from townspeople, who came to buy pork, eggs and cream. The humans and animals consuming the grain of most farmers, however, live up-road, have no face and are hard to relate to. They are the “world” that needs to be fed. They are the “market”, whose “laws” seem inscrutable. What happens to human and animal bodies when they are exposed to agrochemicals becomes immaterial, inconsequential. Most farmers are quick to latch onto counter-narratives in spite of the public outcry against glyphosate.

This capacity of blanking out the consequences of their farming practices does not correspond to an emotional shortcoming, nor to a lack of compassion; it is what Donna Haraway following Hannah Arendt, calls “a deep surrender” to the “evil of thoughtlessness”. It is an inability to make present what is absent, an inability to “track the lines of living and dying”, to “cultivate response-ability [...] The world does not matter in ordinary thoughtlessness”. This inability is not specific to industrial farmers. It is in all of us, when we become “astralized right out of the muddle of thinking, into the practice of business as usual, no matter what” (Haraway 2016, 36). Observing fields through drones is conducive to this astralization.

We are here at the very heart of the problem of how human action becomes irresponsible to others humans and non-humans. This ordinary thoughtlessness is not only a problem of individual attitude, or capacity, though. It is linked to a social and economic system that isolates and alienates individuals, here the farmers, pitting them against one-another as competitors, encouraging them to abstract/astralize from concrete bio-physical relations to count in purely monetary terms.

Both, biotech and organic farmers in Saskatchewan, claim to be the real steward of the land. They use the same discourses while prioritizing different practices. Both compete for the hearts and minds of the consumers redefining the “moral high-ground” in farming (Gertler, Jaffe, Beckie, 2018, 165). The controversy about appropriate practices does not mean that all practices are mutually exclusive: some biotech farmers experiment with crop rotation and nitrogen fixing plants and many organic farmers try to devise methods, that disturb the soil as little as possible. The controversies reflect a much larger conundrum about the types of

knowledge that farmers trust, the visions of the world they draw on and the priorities of speed, size and output they set, when they cultivate their fields.

If farmers cease to use agrochemicals, does organic farming bring them back to the ground? Most organic farmers, I spoke to, did not stop to use chemicals because of an abstract feeling of responsibility for the environment or for the health of the consumers. Most did so for financial reasons and also because their wives were concerned about their husband's health. Stanley Waters, a radical activist in farm politics, cultivating 930 hectares, told me that he became an organic farmer in 1992, because the cost of chemicals was so high and because he did not want to be under the thumb of chemical companies. His wife Maureen supported him in this decision convincing him, that spraying would damage his health. Also, she felt it was not right to grow something healthy and then sprinkle chemicals all over it.

Both were less concerned, however, about consuming food sprayed with chemicals themselves and have only recently started to eat some organic food.¹² As a matter of fact, most organic farmers I had meals with, did not consistently eat organic food. The pioneer of modern organic farming in the province, Edwin Lord, decided to cut out pesticides as early as 1969 because he could not pay for them and felt trapped in a cycle of debt. Only when his newly wedded wife, who worked at the local library, brought home Rachel Carson's book 'Silent Spring' (Carson 1962) on the effects of DDT, she was able to convince Edwin to become more cautious with chemicals. He began to observe more closely, what happened in his field:

¹² When we had dinner at their house Maureen served me a lavish display of fruits and vegetables on a big disposable plastic platter that she had bought ready to use, conveniently cut up in the supermarket. Stanley loved meat and hated vegetables anyway. He was amused about a neighbour, a conventional farmer who came to buy organic lentils from him for home consumption although he grew non-organic lentils himself.

When you spray you make a round with your sprayer and then you look, whether the weeds are curling up. With 2,4D the weeds go into accelerated growth, because they are starting to die. I started thinking, if these weeds are shrivelling up after I have passed them over with 5 miles/hour, what about myself after twenty years of herbicide exposure? (Interview 14 August 2003)

In contrast, farming organically and growing clover as a biannual gave him the sensorial experience of doing the right thing: “The convincing thing that happens if you plough down a field of clover four feet high, the convincing thing is the smell of clover. You know that you are on the right way. You feel that this is good for nature. You are building up the soil fixing nitrogen in the soil.”

Organic farming also meant putting up with more unpredictability and higher risk. I went on crop tours with many organic farmers, and all of them told me, that the timing of each farm operation was decisive to help the crop get ahead of the weeds. Nitrogen loving weeds, such as wild mustard, responded to clover plough-down and thrived, so that it became impossible to grow flax. Wild oats seeds buried in the ground for years, germinated, when the field was cultivated. So, organic farmers had to wait until after the wild oats came up, to till the field and seed the wheat. They were raving about the ideal situation, when a thin crust on top of the soil made it impossible for the weeds to germinate but allowed the wheat to come out. A sudden rain shower could easily destroy this advantage, though, and bring up a new flush of weeds.

Over the years, Edwin taught himself to farm organically, rotate his crop and towards the end of his life he even established his own test plots to experiment with cereals under-seeded with

legumes. At the same time, he asked more and more questions about the pesticide charge in the drinking water of the province, looked into cancer rates in the rural population, and campaigned unsuccessfully over years to have the synergetic effect of the mixture of different agrochemicals on the soil officially tested: “In Saskatchewan we have the highest rate of breast cancer in Canada, the second highest rate of prostate cancer and we use one third of all pesticides in Canada. There is no doubt in my mind that the pesticides are responsible for the cancer. People don’t want to recognize that”. His explanation for this unswerving denial was addiction: “we have chemical addiction mainly in men. If you are an alcoholic and you wake up in the morning and you don’t know, where to get a drink you get in a panic. If you tell chemical farmers across Canada that from tomorrow they would not be able to buy any more chemicals, they would get into a panic too.” Somebody in a state of panic cannot reflect about his actions anymore, gripped by a sudden sensation of fear, which is so strong as to dominate or prevent reason and logical thinking, replacing it with overwhelming feelings of anxiety and frantic agitation. Edwin did not attribute an individual responsibility for excessive chemical use to the panicked farmers alone, though. He believed in government regulations, in the obligation of those elected to serve the common good and protect consumers and farmers from intoxication. He was disgusted with the complacency of elected representatives: “this god-dam government is working with the corporations to exploit the family farm. I am writing an awful lot to the prime minister to denounce this co-operation.” From Edwin's first step to look critically at his farming practices and change them accordingly, followed a flurry of reflections, insights, and ultimately a political engagement. It was getting back to the ground, getting back in touch with his soil, that sparked his concrete reflections and political demands jumping scales in consciousness and action.

These pioneers of organic farming in Saskatchewan were *eigensinnig* (Müller2019), stubborn and independent in their thinking and capable of translating the meaning, they had given to things into action. One of the most stubborn farmers, I met, and also the most committed to his soils, was Paul Ernst an organic farmer from Alberta. He admitted that the adjective *eigensinnig* characterized him very well. An immigrant from Germany, he had started a farm in 1982 by clearing three quarter sections of forest-land, felling the trees and simply burning them. He then cultivated the fields and discovered, that the soil was carried away very easily by erosion. His concern with soil erosion made him one of the early adopters of no-till using herbicides, in particular glyphosate. In the 1990s, he observed that his wheat was changing its colour. Instead of a lush yellow at harvest time, it was somewhat grey. Ten years later, in 2003, he wanted proof for his suspicions and grew wheat sprayed with glyphosate next to the same variety on the adjoining plot, that he did not spray. The difference in colour and crop health convinced him, that he was poisoning his land and he decided to farm organically, while trying to re-establish soil fertility by adding the missing minerals by supplementing large amounts of wood ash. His judgement of his fellow farmers was harsh: “they think they are so perfect that they do not need any more information. They do not want to hear anything that does not fit into their model. They do not know, what they are doing.”(conversation 2010) He explained, that most of the soil organic matter, that no-till farmers were so proud of, was in fact dead material, as the microorganisms of the soil had been seriously inhibited by agrochemicals and prevented from producing lively humus. In the last twenty years, he spent enormous time, money and energy to make his land fertile again and had finally excellent yields on his organic crops. However, although he loved growing grains, he came to the conclusion that large parts of prairie land should go back to grass. He gave me his calculation. As 70% of all grains grown on the prairies were fed to animals in industrial livestock operations and feedlots, one could transfer 70% of the land back into grass and make the

animals graze the land intensely instead. Back to perennial grasses and breeding perennial wheat, was also the dream of Wes Jackson at the Land Institute in Kansas whose experiments with building an agriculture the way nature's ecosystems work, were watched by many organic farmers in Saskatchewan with great interest (Robbins 2014).

Cutting out the use of agrochemicals obliged organic farmer to attend more closely to their soils and crops. As they could not rely on simple, large-scale and fast solutions for dealing with weeds and soil fertility any more, they were confronted with the necessity to observe, learn and respond to the needs of their soils. The pace required by their ecological soil care was slower than the speed with which their conventional neighbours could spray their crops. To farm organically cut out dependency on the input side, however, required more time. Farmers had to get back in touch with the warmth of things, as Adorno would say (Müller 2015). It was not a panacea, though, as organic farmers were not protected from the competitive disciplines of capitalist markets, and the pressure to scale up was ever present.

Conclusion:

Zero-till farmers care for soils and crops in a way. However, when they encounter resistance from the muddle of resisting weeds, sprawling fungi and unruly soil bacteria and feel attacked by concerned food consumers, they do not attribute their problems to a fundamental flaw in their model of production, but rather to their own shortcomings in implementing it. Because their industrial production methods hinge on a series of biophysical overrides, the inclination is always to turn to yet another technological fix. (Weis 2010, Moore 2012) Their productionism transformes care “from a co-constructed interdependent relation into mere control of the *object* of care” (Puig de la Bellacasa 2015, 10, her italics). In this utilitarian

vision, soil becomes mere substrate for selected plants which are fed artificial fertilizers with little consideration for wider ecological effects and whose competitors are sprayed out. This drives large farmers into an unholy alliance with the very agrochemical companies, that profit from selling them more and more inputs. As I have demonstrated, these companies are now increasingly offering them not only inputs, but also a fully constructed legitimating discourse and an astralized vision of an intact industrial farming model reassuringly under human control. They also attempt to marshal some big farmers as key public messengers. Zero-till modifies existing relationships, creates both, autonomy and dependence, care and disintegration. The more-than-human entanglements, that are woven around this master plan are ambiguous and contradictory. It gives prominence to some human and non-human actors and makes others disappear. Hence, engineering crops to resist herbicides, favours the reduction of certain weeds while encouraging the proliferation of others, and threatening organisms present in the ecosystem whose existence is not (yet) considered or valued scientifically or economically.

Can addicted farmers divorce from herbicides? Are there real alternatives to glyphosate and its even more toxic successors and predecessors and varied amalgams? To suppress weeds, organic farmers practice companion cropping, invent ingenious mechanical devices — like broom chasers, crimper rollers. Some of these methods have been taken up by industry. Researchers are also busy investigating options like “blasting” weeds with grit, “cooking” them with steam, or “frying” them with electricity, though none of these options are in current widespread use. Computer and robotic technology is helping to make mechanical weed control more efficient and effective: farmers use GPS systems to guide their equipment down crop rows, and sensors can even distinguish between vegetable plants and weeds. Bayer now fused with Monsanto, has long invested in digital agriculture. They hold huge databases. They

begin to sell information on soil composition, weed pressure and weather together with their seeds, their genetic traits and their chemicals, and thus create new packages of “weed solutions”, that they can sell to farmers. Beneficial soil bacteria and fungi are patented as soon as they are discovered. Agribusiness strategists explore new juicy business opportunities beyond glyphosate. At the same time, the industry tries to stretch out its continuing use indefinitely.

Is that the type of agriculture we want? Do we want computers and robots to feed us and replace the last farmers on the land? Is the sensorial capacity of perception, that farmers developed over millenaries of working with soils and seeds, superfluous? Will machines better than humans at last outsmart, what farmers call weeds? Are weeds really the enemies of food, as the verb weeding out, putting to waste, indicates? The consuming public is becoming increasingly wary in spite of industrial farmers attempting to assure them that chemical-intensive farming is safe for their health and the environment. Organic farmers increasingly consider soils as endangered living worlds (Puig de la Bellacasa 2015, 2), while soils remain for most, also a resource for value extraction. Their care is political, messy and dirty, not an innocent category (Haraway, 2016, Kortright, 2013, Puig de la Bellacasa, 2015). It is the plant — soil community itself, that obliges farmers to pay more attention and to slow down. Weeds resistant to herbicides can become unexpected allies of organic farmers. Century old farming skills, that got lost in the chemical revolution, are relearned. Hope lies in this re-emerging respect for the complexities and interconnectedness of life.

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