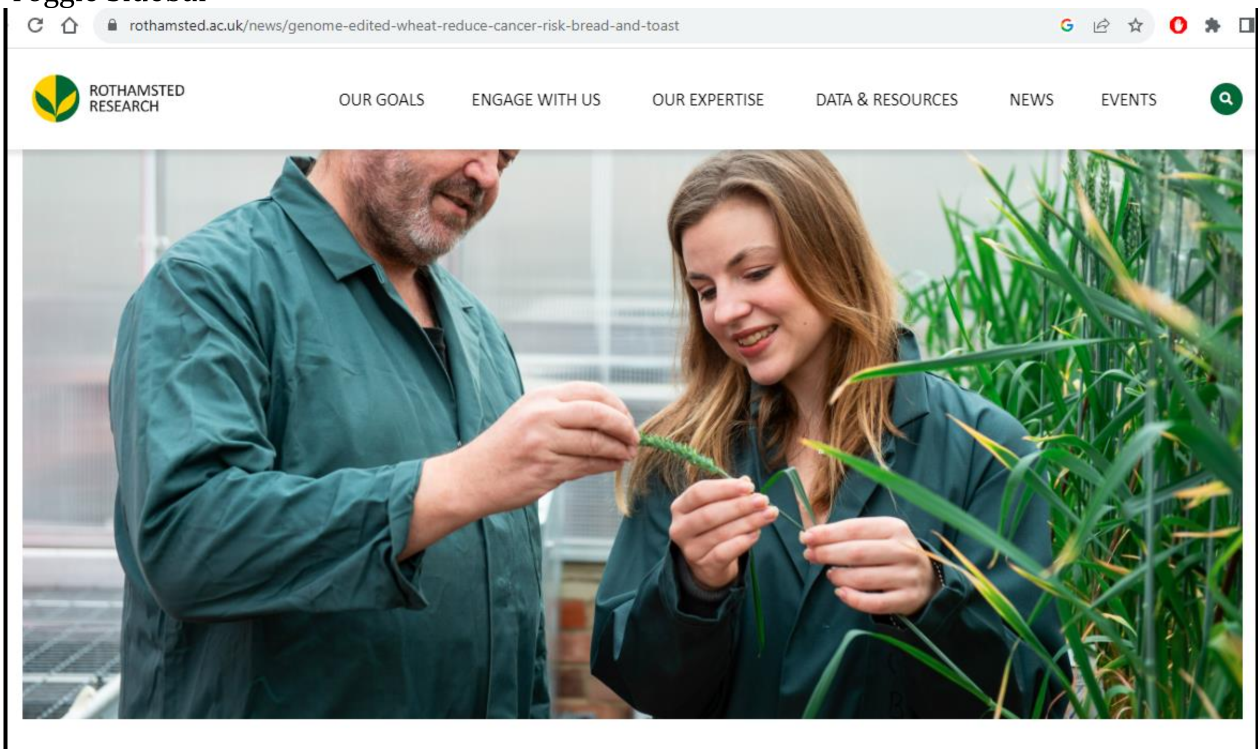
VermEcology

Worms make soil, soil makes ecology – says it all.

Toggle Sidebar



These serious concerns have led Raffan, Halford and colleagues to attempt to produce low asparagine wheat using genome editing.

11 November, 2023

Roth Rebu

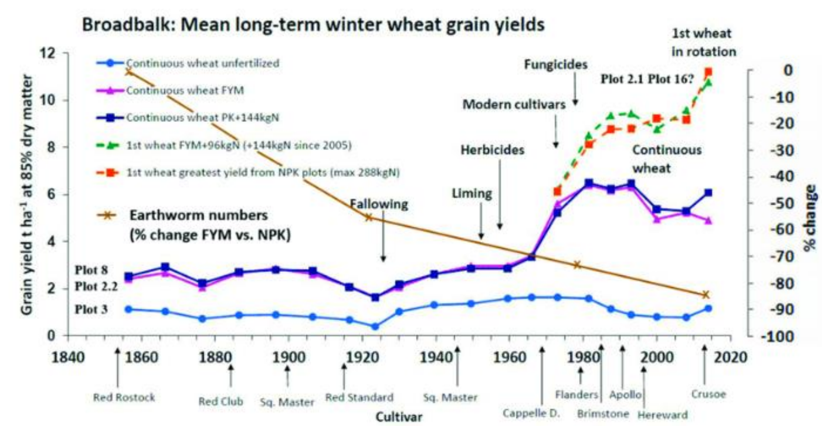
A Rip on ROTHamsted as it is REBUked & REBUtted

by R.J.Blakemore PhD Agroecology & Earthworm Eco-taxonomy, Kangaroo Valley, NSW. 11th Nov., 2023.

One of the world's longest running experiment, operational for almost 185 years since 1839, is at Rothamsted. Its aim was to test whether synthetic fertilizers could replace organic composts or manures in routine use up to that date. In particular, their patented Superphosphate was tested along with synthetic nitrogen, initially ammonia-based and later using the military explosive Haber-Bosch nitrates. Later, from 1950s especially, toxic biocides (called herbicides, fungicides, etc.) were added to their mix.

The main concern was crop yields, the soil was a subsidiary interest, but soil biota were mostly ignored. This is perhaps excusable in times preceding Darwin (**1881**) initiation of the concept of Soil Ecology. Soil fauna & flora, when looked at (e.g. Morris **1922**, **1927**), were found obliterated in acidic chemical plots.
Periodic reports have claimed that synthetic N-P-K yields were higher than the unfertilized control plots. What is underemphasized is that the organic Farm-Yard-Manure (FYM) plots often yielded as much, or significantly more, than NPK. Moreover, the soil was rapidly acidified in the chemical plots, soil organic carbon (SOC) and soil moisture were depleted, and soil fauna was destroyed – especially the earthworms. Lime, herbicides, fungicides and other interventions were introduced and various plant varieties were grown, but the planned GMO crops have only had preliminary trials thus far from my understanding (as noted below). Meanwhile, if the goal is just yield, the organic plots 'hold their ground' while keeping beneficial soil characteristics. In addition to yield equivalence, or excellence, 100% healthy organic food from elsewhere is undepleted in nutrients & void of toxic poisons thereby offering substantial advantage.

When organic advantages *are* reported, these are almost invariably quoted as being raised from the chemical data, just as chemical data is claimed higher than unrealistic zero fertilizer plots. Yet in factual reality, since the starting convention has always been organic, their synthetic and toxic chemical data are truly ***diminished*** from organic baseline data. What they have ***actually proven*** is that **chemical has failed**.
Rothamsted started as and remains partly a commercial facility run for profit mainly by chemists who de-emphasize the organic benefits and never report on the many advantages of organic farming (their competitor), this despite their experiment being a spectacular failure. The need is to admit this and to change tack. Supporting data presented herein is from Rothamsted's own sources, assumed to be factual. A good starting point, or a flourishing finale, is the data from their Broadbalk winter wheat trial:



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Rothamsted's Broadbalk wheat yields from 1855-2017 or >130 years (e-RA [22]) showing FYM equivalent to NPK yields throughout; here overlain with unsustained earthworm counts (from Morris 1922, Edwards & Lofty 1982, Sizmur et al. 2017) as % change in FYM vs. NPK (or, only in 1921, unfertilized) plots, clearly showing that chemicals kill worms. Note that the highest periodic rotation wheat yields of ~10 tha −1 just match wheat yields of 9.9 tha −1 as certified from an organic farm in Bhopal, India-three times (or +200%) the local Indian average [48: Appendix].

In the figure above I overlaid their yields and treatments with the earthworm status (brown line) in chemical vs. other non-chemical plots over time (see – **https://www.mdpi.com/2571-8789/2/2/33/htm**). What this figure above clearly shows is that natural organic (FYM) has easily matched their synthetic chemical (NPK), thus **their experiment failed from the get-go**. Moreover, the false impression is that crop rotation doubled yields, e.g. as originally from turnips (dunged) 1839, barley 1840, peas 1841, wheat 1842 and oats 1843. What this truly shows is that dropping the standard & ancient practice of crop rotation (e.g. **https://en.wikipedia.org/wiki/Crop_rotation**) depletes periodic wheat yields by half…

This was realized from earlier reports in the 1980s with rotational wheat, potatoes and beans showing the FYM plots invariably had yields far above the means for the chemical plots

(e.g. **https://repository.rothamsted.ac.uk/download/fd1bb4441b1ccab26e6ff80ed33c1e650eb972fb292645a9eaba580e776f3903/16631759/mpdf.pdf** Table 2A).

As for the other crops in rotation on Broadbalk, oats and maize also have much higher yield with FYM:-

Table 2. Broadbalk; mean yield of oat grain (2011-2015) and forage maize (2008-2012)

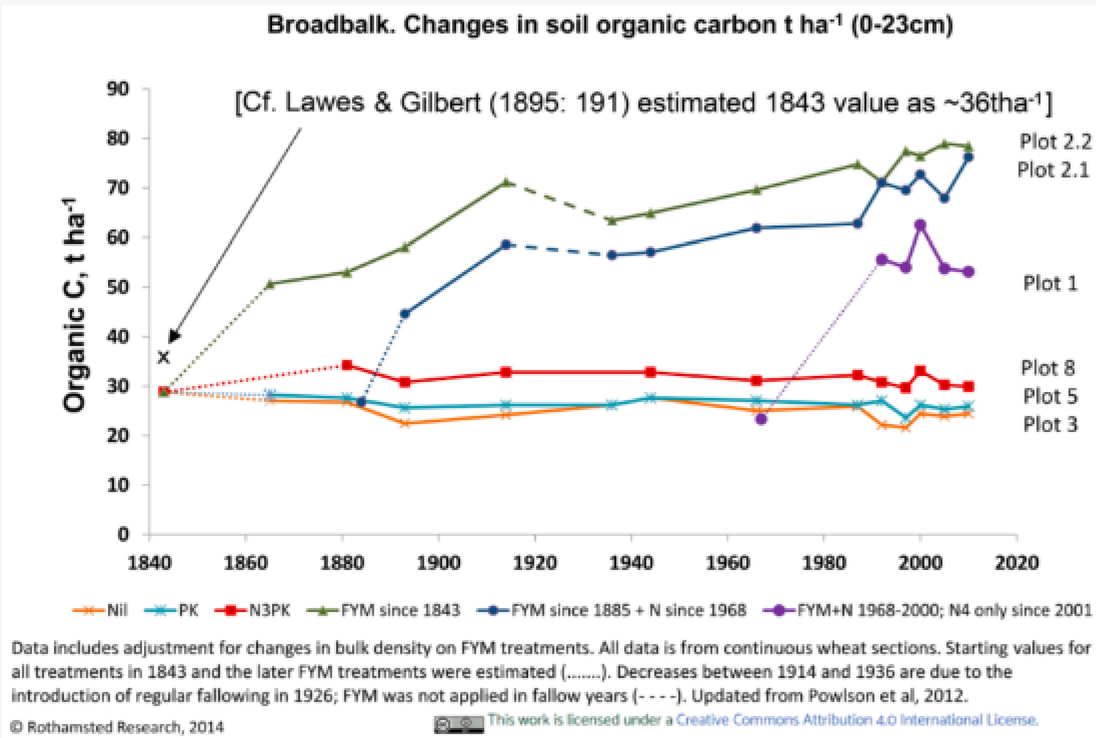
Strip	Treatment[1]	Oat grain t ha^{-1} 85% DM	Forage maize t ha^{-1} total DM
3	Nil	1.9	1.7
5	(P)KMg	2.1	3.9
6	N1 (P)KMg	2.3	6.2
7	N2 (P)KMg	2.5	8.8
8	N3 (P)KMg	3.2	8.8
9	N4 (P)KMg	3.2	8.9
15	N5 (P)KMg	4.5	9.1
16	N6 (P)KMg	5.5	8.3
2.2	FYM	6.6	12.0
2.1	FYM N3	7.0	14.6
1	(FYM) N4	5.7	12.6

[1] See Table 1 for details

Note; No N fertiliser or FYM was applied for the winter oat crops.

The FYM vs. NPK oats are about 7 vs. 3 t/ha (**a decline of -57%**) and maize 12 vs. 8 t/ha (**-33%**). (Table 2 source Rothamsted Long-Term Experiments Report 2018 that is no longer accessible on their website – **https://web.archive.org/web/20210909081747/https://www.rothamsted.ac.uk/sites/default/files/RRes_LTE%20Guidebook_2018_%20web%20AW.pdf**). Without shame, this report also notes: "*The microbial biomass of the FYM plots is approximately* *twice that of the plots given either NPK or no fertilisers (Jenkinson & Powlson, 1976)*." In other words, **microbial activity is halved** in chemical NPK plot vs. in organic FYM plots. Ditto declines of SOC:-

Figure 10. SOC at Rothamsted's Broadbalk (from e-RA), with comment that starting values may have been higher, even than Lawes & Gilbert (1985) estimated; note too that FYM plots' SOC are plateauing whilst in NPK, or PK alone, it remains depleted. Often correlating with SOC/SOM, earthworms in FYM plots 1–2 are likely nearest original/optima as found in fields organically managed by tradition/convention prior to introduction of synthetics fertilizers in the 1840s.



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Salter, P. J., & Williams, J. B. (1969). *The moisture characteristics of some Rothamsted, Woburn and Saxmundham soils. The Journal of Agricultural Science, 73(01)*, 155. doi:10.1017/s0021859600024242

10.1017/s0021859600024242

The moisture characteristics of some Rotha... 1 / 4 — 144% +

Table 1. *Amount of farmyard manure (FYM) applied and percentage of organic carbon in certain soils at Rothamsted, Woburn and Saxmundham*

Experiment	Plot	Treatment	Sampling depth inches	% C* in air dry soil	Annual dressing of FYM tons/acre	Number of annual dressings	Amount of FYM applied tons/acre
Rothamsted							
Barnfield	4/0	PKNaMg	0–9	0·9	0	0	0
	2/0	FYM (plus PK)	0–9	2·6	14	124	1736
Broadbalk	8	NPKNaMg	0–9	1·0	0	0	0
	2B	FYM	0–9	2·6	14	112	1568
Park Grass	6	PKNaMg	0–9	2·7	0	0	0
Woburn							
Lansome	50	NPK	0–9	0·9	0	0	0
	80	FYM	0–9	2·3	30	25	750
Stackyard							
Continuous barley		PK	0–9	0·8	0	0	0
1st year arable after 3-year ley		NPK	0–10	1·9	0	0	0
Saxmundham							
Rotation 1	10	NPK	0–6	1·3	0	0	0
	1	FYM	0–6	2·0	6	69	414
Rotation 2	1	None	0–9	1·0	0	0	0

* Walkley-Black method; % C as determined × 1·3.

The main effect of agrichemicals is to destroy soil organic matter (SOC), often >50%, along with its soil biota. **The SOC ("*% C*") in Broadbalk FYM plots was 2.6 compared to NPK of 1.0, or a difference of -62% (or +160% in their world!)** a substantial difference equivalent to greater carbon storage sequestration! Other beneficial soil characteristics such as crucial soil moisture – held in the soil by humus & due to earthworm burrows – are also greatly diminished in chemical plots. As in FYM comparison data here:

The moisture characteristics of some Rotha... 2 / 4 — 107% +

Table 2. *Mean percentages of soil moisture (w/w) retained at different matric suctions and the available-water capacities of the surface six inches of certain soils at Rothamsted, Woburn and Saxmundham*

Location	Rothamsted					Woburn				Saxmundham			
Site ... cropping treatment	Barnfield, continuous roots		Broadbalk, continuous cereals		Park grass, permanent grass	Lansome, continuous roots		Stackyard, continuous arable		Rotation I, continuous arable		Rotation II, continuous arable	S.E. of difference*
	−FYM	+FYM	−FYM	+FYM		−FYM	+FYM	Cereals	Ley	−FYM	+FYM	−FYM	
Suction (atm)													
0·05	21·6	25·5	21·5	24·1	33·0	12·2	20·1	13·9	20·1	22·7	24·3	21·6	±0·41
0·33	16·7	21·1	15·9	18·7	26·4	10·6	15·7	12·1	15·9	19·3	20·3	17·4	±0·58
1·0	15·6	19·3	—	—	23·0	8·8	13·2	10·5	13·1	18·2	19·9	16·5	±0·48
2·0	14·9	18·1	—	—	20·4	7·8	11·9	9·4	11·5	16·8	17·2	15·4	±0·43
15·0	11·9	14·0	11·1	10·4	13·8	4·2	8·1	5·5	6·8	12·2	12·3	11·3	±0·45
Apparent specific gravity (g/cc)	1·24	1·18	1·30	1·30	1·22	1·59	1·28	1·65	1·31	1·43	1·28	1·37	±0·027
AWC (in/6 in soil)	0·72	0·82	0·82	1·07	1·41	0·77	0·92	0·83	1·04	0·90	0·92	0·85	±0·044
(in/9 in soil)	—	—	—	—	—	—	—	—	—	1·35	1·38	1·27	—
(in/12 in. soil)	1·73	1·91	1·92	2·30	2·75	1·59	1·95	1·78	2·18	—	—	—	—

* There is a minimum of 20 degrees of freedom. Each value in the table is based on three cores from the same location within the plot and the standard error has been calculated from the between-core error. The standard errors are for comparing differences between two soils.

P. J. SALTER AND J. B. WILLIAMS

The AWC (Available-Water Capacity) in Broadbalk FYM plots was 1.07 compared to -FYM of 0.82, or a difference of -23% (+30% in their world!) a substantial difference equivalent to having extra rain! Interestingly, this -23% value is about the same as "*soil moisture is reduced by –22.3%*" in my 2018 paper.

Established in 1839 with the unfertilized field allowed to run down for four crop seasons, after >80 yrs of treatment, Morris (1927) in these early days found all invertebrates near obliterated by -86% with almost complete 100% annihilation of Oligochaeta (earthworms) in N (Am.Salts) & P (Super) vs FYM (Dung) plots:

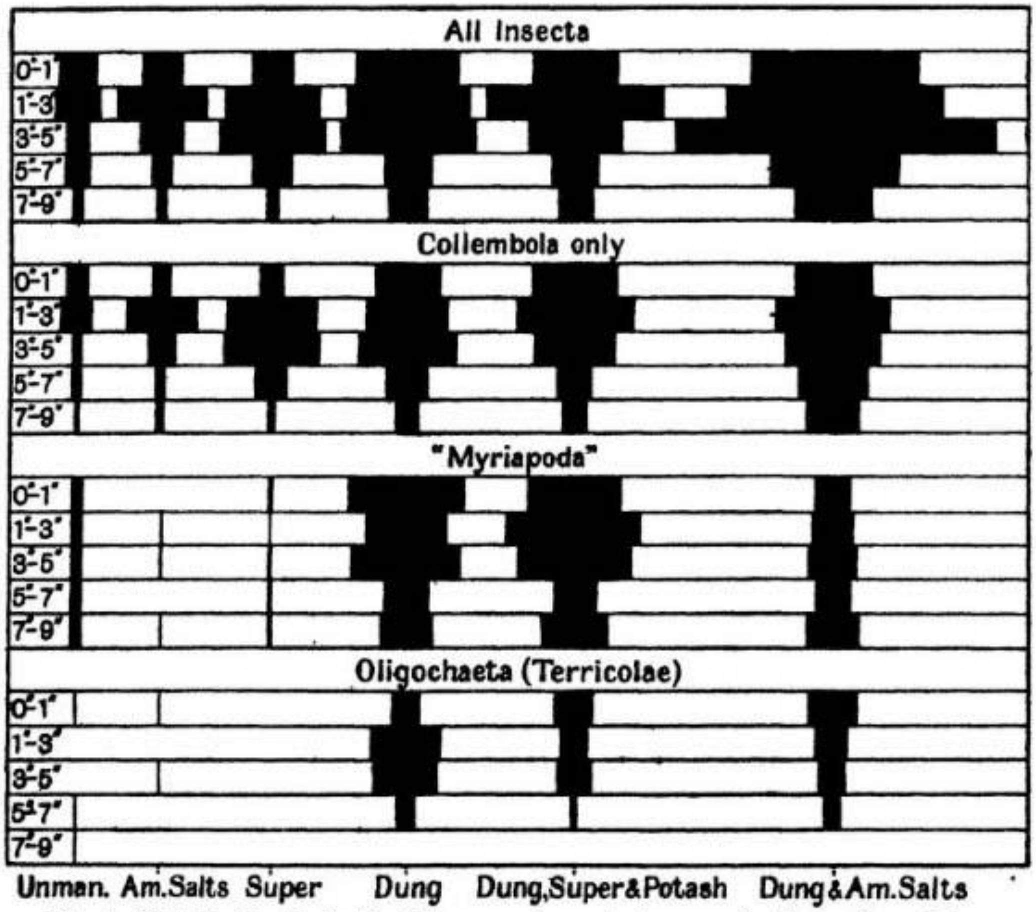
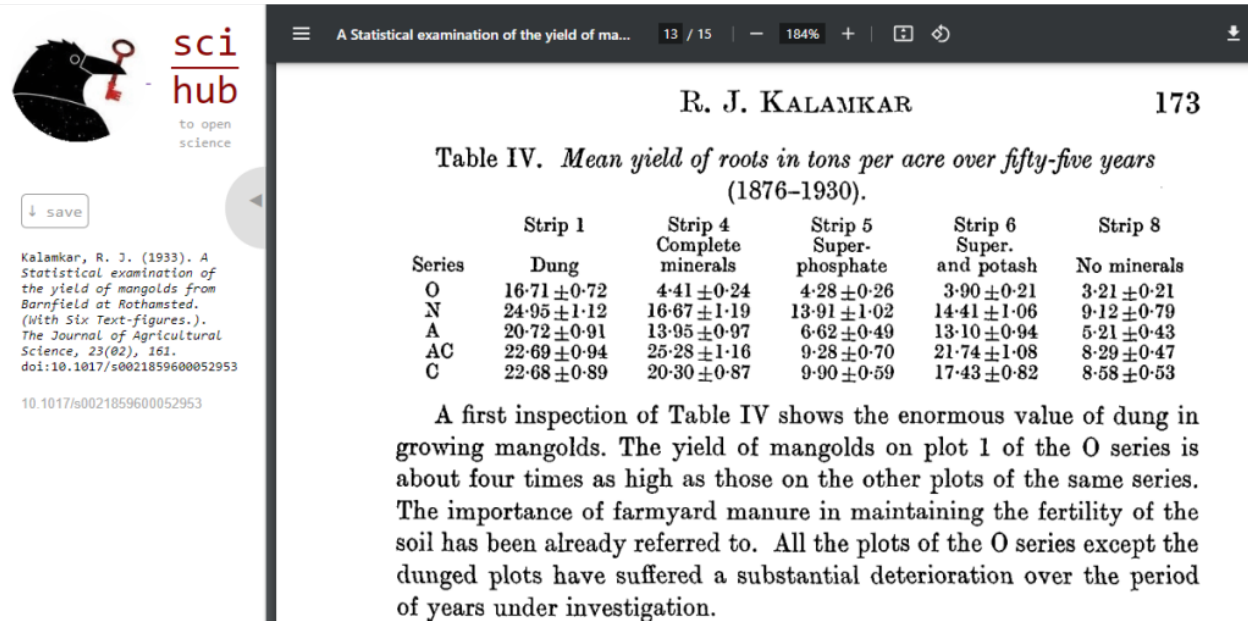


Fig. 3. Distribution in depth of the more important groups in the various plots.

Rothamstead data on earthworms (Oligochaeta) from Morris (1927: fig 3 - https://archive.org/details/in.ernet.dli.2015.18345/page/n493/mode/2up).

[Major flaws in Morris's (1927) study are possible inter-plot insect migrations, that samples were taken in different seasons and omitted pH data; however, Morris (1922,) corroborates the nil (Unman.) vs. FYM (Dung) treatments after 80 years with -66% difference in total invertebrates without any seasonal effects]. (Ref.). Does FYM and regular earthworm activity maintain natural soil fertility and crop productivity? See:-



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Kalamkar, R. J. (1933). A Statistical examination of the yield of mangolds from Barnfield at Rothamsted. (With Six Text-figures.). The Journal of Agricultural Science, 23(02), 161. doi:10.1017/s0021859600052953

10.1017/s0021859600052953

A Statistical examination of the yield of ma... 13 / 15 184%

R. J. Kalamkar 173

Table IV. *Mean yield of roots in tons per acre over fifty-five years* (1876–1930).

Series	Strip 1 Dung	Strip 4 Complete minerals	Strip 5 Super-phosphate	Strip 6 Super. and potash	Strip 8 No minerals
O	16·71 ± 0·72	4·41 ± 0·24	4·28 ± 0·26	3·90 ± 0·21	3·21 ± 0·21
N	24·95 ± 1·12	16·67 ± 1·19	13·91 ± 1·02	14·41 ± 1·06	9·12 ± 0·79
A	20·72 ± 0·91	13·95 ± 0·97	6·62 ± 0·49	13·10 ± 0·94	5·21 ± 0·43
AC	22·69 ± 0·94	25·28 ± 1·16	9·28 ± 0·70	21·74 ± 1·08	8·29 ± 0·47
C	22·68 ± 0·89	20·30 ± 0·87	9·90 ± 0·59	17·43 ± 0·82	8·58 ± 0·53

A first inspection of Table IV shows the enormous value of dung in growing mangolds. The yield of mangolds on plot 1 of the O series is about four times as high as those on the other plots of the same series. The importance of farmyard manure in maintaining the fertility of the soil has been already referred to. All the plots of the O series except the dunged plots have suffered a substantial deterioration over the period of years under investigation.

The mangolds in Dung (FYM) plot is 16.71 t/ha vs. Complete minerals (NPK) is 4.41, a reduction of -73%!

Yet the most startling data – mostly ignored – is perhaps that most foods, as well as a toxic burden, are now deficient in nutrients. This loss has been intensified globally and is also measured at Rothamsted's Broadbalk crop since about the mid-1960s (see – https://vermecology.wordpress.com/2023/08/29/critical-decline-of-minerals-nutrients-in-agrichemical-vs-100-organic-foods/). Do not be deceived that this also occur in genuine organic produce as their FYM pseudo-organic plots grains are not at all "organic" due to depleted feedstocks feed to the farmyard animals, and herbicides, fungicides & other agrichemicals used.

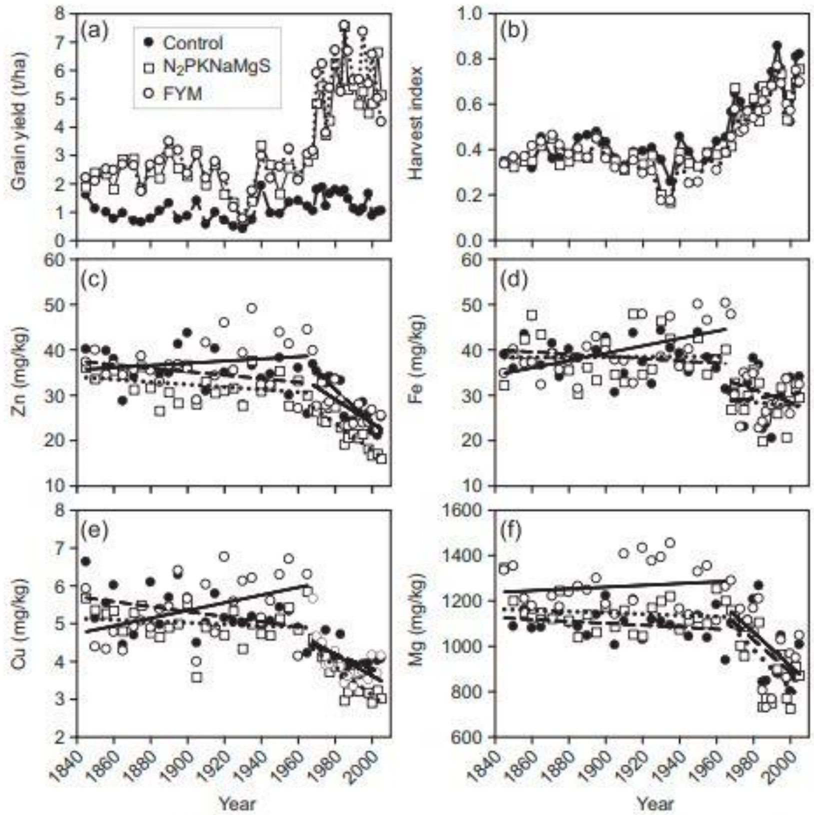

Fig. 1. Trends in wheat grain yield (at 85% dry matter) (a), harvest index (b), Zn (c), Fe (d), Cu (e), and Mg (f) concentrations in wheat grain from three plots of the Broadbalk Experiment since 1845. Regression lines are shown for (c)–(f): dashed line for the control, dotted line for N_2PKNaMgS, and solid line for farmyard manure (FYM). The slopes of the regression lines are shown in Table 2.

Can you see the dramatic declines? Iron (Fe) for example, crashed from about 40 mg/kg from the start up to the 1960s to about 20 mg/kg thereafter, or about a 50% decline! What changed in the 1960s? Well the so-called "**Green Revolution**" got into full swing. As I explain, and as in the chart above, herbicides were routinely used (and glyphosate that expanded from 1970s is a patented **metal chelator** with all kinds of problems), also the need was for increasing amounts of synthetic fertilizers causing pollution & acid soils. More below…

https://www.era.rothamsted.ac.uk/metadata/rbk1/OUTREACH/Lessons-from-Broadbalk-Slides-V2-2021.pdf; **https://images.newscientist.com/wp-content/uploads/2021/03/08155939/lessons-from-broadbalk-instructions-pdf.pdf**. This is a most interesting expose from Rothamsted as they sort of hint at their problems – **https://web.archive.org/web/20230626122838/https://www.rothamsted.ac.uk/articles/seven-things-we%E2%80%99ve-learnt-world%E2%80%99s-oldest-experiment** . [*With my comments in square braces*]:-

"*In the wake of our recent Long Term Experiments conference, we asked a few of our experts to suggest seven key things Broadbalk has taught us*:

How to feed the world

First up, Broadbalk has achieved its initial aim of showing us how good yields of wheat can be achieved from the same field for 180 years with either inorganic fertilizers or manure. At the time the experiment was set up, typical wheat yields were about 1 tonne per hectare. Today, we've reached yields that can exceed 12 tonnes through careful management ensuring that soil acidity, weeds and diseases do not compromise the experiment – whilst the introduction of short-straw cultivars in the lates [sic] 1960s led to game changing increases in grain yield. [*They fail to mention an accompanying 50% nutrients loss!*].

Much of the knowledge of how to successfully grow wheat, knowledge which we now take for granted, originally came from what Broadbalk taught us. But it's important to remember the part wheat has played in the history of mankind, as increasing wheat yields played a large part in fuelling the rapid growth of European cities in the late 1800s, and the 1960s green revolution that transformed the developing world [*that was as much due to the massive expansion of irrigation while using chemicals that destroyed soils*!].

Soil carbon and climate change

Initially developed for the soil data from Broadbalk, the RothC model is now used the world over to simulate the dynamics of carbon in soils – including grasslands, woodlands, and even volcanic soils. Taking into account soil type, climate and plant cover, it successfully mimics the fate of carbon in soils over decades from small experimental plots right up to the global scale. [*Despite their spin, on the ground, Broadbalk definitively showed the blatantly obvious – adding FYM organic matter maintained SOC, chemicals destroy SOC with at least 50% loss. Another complete chemical disaster for Rothamsted!*].

Our current understanding of how soils will affect, and be affected by climate change, is in large part, thanks to the RothC model, which wouldn't have been possible without decades of soil samples collected from Broadbalk. [*Surely they can understand by now that their chemical farming has caused this problem?].*

When not to use fertiliser

Data from Broadbalk was instrumental in stopping the routine application of nitrogen fertilizer in autumn by cereal farmers in the UK, as it was clearly demonstrated how inefficient (and harmful) this was, with most being lost to the air or soil. Separate analyses of the drainage water from Broadbalk also led to important developments in our understanding of soil phosphorus leaching, which results in excess fertiliser encouraging harmful algal blooms in freshwaters. [*Please check these drainage results published by Russel, my* ***2018*** *paper says*: "*Rothamsted's erstwhile director, Sir John Russell (1940) [****83****] found Broadbalk's FYM plot had less run-off compared to the adjacent Nil plot: from 1903–1914 they drained on ten against 232 days, respectively, showing not only that water is stored in humus and at depth in soil (due mainly to earthworm activities), but also how soil erosion and nutrient leaching may be almost entirely reduced even with mediocre organic management.*" See – **https://archive.org/details/in.ernet.dli.2015.78087/page/n253/mode/2up?q=broadbalk**].

Broadbalk not only shows us the value of adding fertilisers but also the point at which we need to stop – where diminishing yield returns are not worth the financial cost or the environmental impacts. [*What! This was found early on when FYM plots out-yielded NPK, and their destruction of soil as noted >100 years ago*!].

The impact of acid rain on soils

Excess nitrogen is considered one of the major drivers of global biodiversity loss. Many human activities release nitrogen and sulphur into the atmosphere, resulting in various types of pollution, including acid rain. Data from Broadbalk showed just how bad things had got in the 1980s, with over 40 kg of nitrogen deposited per hectare. Thankfully, with various measures implemented to reduce nitrogen pollution since, today that number is closer to what it was in the 1880s. Interestingly, a similar decline in sulphur pollution over recent decades has actually led to a deficiency in many agricultural soils. [*Indeed! And what is the source of the excess nitrogen? Mainly the massive amounts of synthetics that Rothamsted still advocates*! *Poulton et al. (**2018**) reported that passive soil acidification on the abandoned woodland wilderness or rewilding at Rothamsted's Geescroft went from pH 7.1 in 1880s to 4.4 in 1999, a -2.7 or >16,000% change!*].

The growing threat of weeds

On plots where herbicides have never been used, yield losses to weeds have been consistently increasing since the 1960s. Less than a third of the harvest was lost to weeds during the 1970s, but between 2005-2014, this had risen to more than half. This is due to weeds doing better than crops in a warming climate, coupled with a shift towards shorter crop varieties that get shaded out by the taller weeds. Many weed species have also benefited over this period from increased use of nitrogen fertilisers whilst many have developed resistance to herbicides. [*What?! Is this a clear admission that herbicides (or pesticides in general) do not work due to weed or pest resistance? How interesting that organic farmers knew this. What really happened is that up to WW1 more men worked in the fields. Proper stocking or extra farmhands can also do the job today if the economics included the environmental & health costs of chemical farming*].

Conversely, these same areas of Broadbalk which has never received any herbicides, provide a refuge for seven plant species that are rare, uncommon or declining nationally, including corn cleavers – one of the UK's rarest plants. These two results further demonstrates the fine balancing act we face in feeding a growing population without harming the planet." [*WHAT?! Again, organic farmers have known about biodiversity all along and, rather obviously, there's a massive difference between food and healthy food*].

[THIS IS THE END OF THE ROTHAMSTED 7 THINGS SECTION].

Here an e.g. of ridiculously complex toxic chemical cocktails non-organic farmers face:

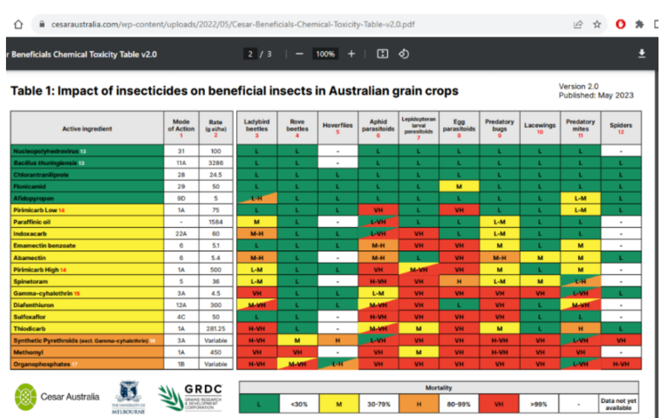

Table 1: Impact of insecticides on beneficial insects in Australian grain crops

Version 2.0
Published: May 2023

Active ingredient	Mode of Action [1]	Rate (g ai/ha) [2]	Ladybird beetles [3]	Rove beetles [4]	Hoverflies [5]	Aphid parasitoids [6]	Lepidopteran larval parasitoids [7]	Egg parasitoids [8]	Predatory bugs [9]	Lacewings [10]	Predatory mites [11]	Spiders [12]
Nucleopolyhedrovirus [13]	31	100	L	L	-	L	L	L	L	L	L	-
Bacillus thuringiensis [13]	11A	3286	L	L	-	L	L	L	L	L	L	L
Chlorantraniliprole	28	24.5	L	L	L	L	L	L	L	L	L	L
Flonicamid	29	50	L	L	L	L	L	M	L	L	L	L
Afidopyropen	9D	5	L-H	L	L	L	L	L	L	L	L-M	L
Pirimicarb Low [14]	1A	75	L	L	L	VH	L	VH	L	L	L-M	L
Paraffinic oil	-	1584	M	L	-	L-VH	L	L	L-M	L	L	-
Indoxacarb	22A	60	M-H	L	L	L-VH	VH	L	L-M	L	L	-
Emamectin benzoate	6	5.1	L	L	L	M-H	VH	VH	M	L	M	-
Abamectin	6	5.4	M-H	L	-	M-H	L	VH	M-H	M	M	L
Pirimicarb High [14]	1A	500	L-M	L	L	VH	M-VH	VH	M	L	M	-
Spinetoram	5	36	L-M	L	-	H-VH	VH	H	L-M	M	L-H	-
Gamma-cyhalothrin [15]	3A	4.5	VH	L	L	L-M	VH	VH	VH	VH	L-VH	L
Diafenthiuron	12A	300	M-VH	L	L	M-VH	VH	L	VH	L	M-VH	-
Sulfoxaflor	4C	50	L	L	-	H-VH	VH	VH	VH	L	L	-
Thiodicarb	1A	281.25	H-VH	L	-	M-VH	M	VH	M	L	H	L
Synthetic Pyrethroids (excl. Gamma-cyhalothrin) [16]	3A	Variable	H-VH	M	H	L-VH	VH	VH	H-VH	VH	L-VH	VH
Methomyl	1A	450	VH	VH	-	VH	M	VH	H-VH	VH	VH	-
Organophosphates [17]	1B	Variable	H-VH	M-VH	L-H	VH	VH	VH	VH	VH	L-VH	H-VH

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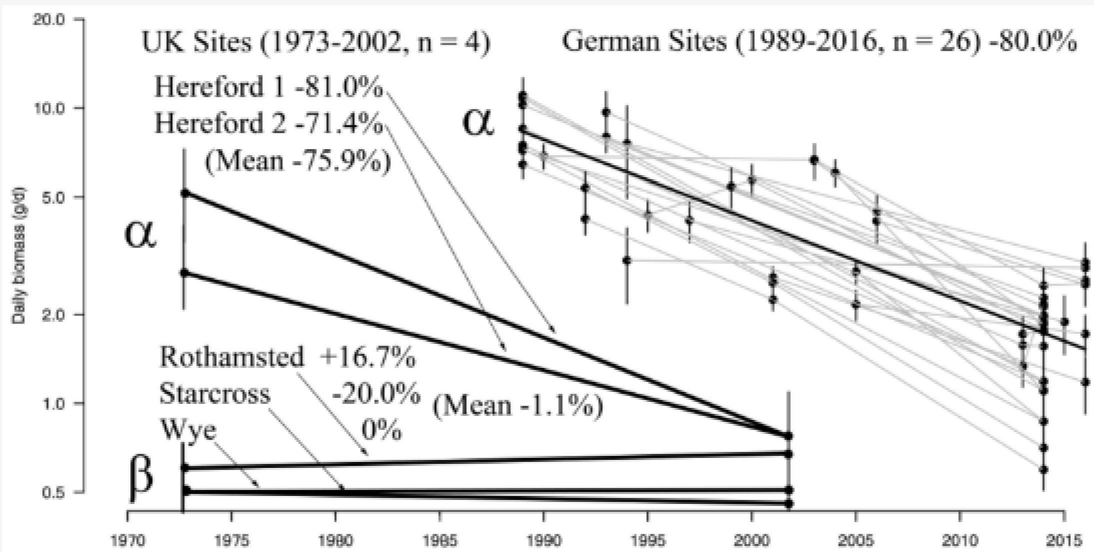
Mortality									
L	<30%	M	30-79%	H	80-99%	VH	>99%	-	Data not yet available

Regarding critical biodiversity declines under chemical agriculture…

Figure 5. UK high-flying insect biomass (g/day) untransformed to comply with German malaise trap data with 95% confidence intervals added; populations with α curves are in decline, β curve fluctuations are for lesser populations that seemingly already collapsed prior to survey.



What the Rothamsted insect surveys (on left side of the chart) found was that insects were being depleted by about 80% except for pests, as my 2018 paper also remarked on, as in the figure above. From Blakemore (**2018a**): "*Moreover, aphids seem especially enhanced rather than depleted by agrichemicals, as was determined from Haughley organic farm's data (Widdowson 1987: 70; Lee et al. 1983; Birkhofer et al. 2008: Figure 5c) [**21**,**32**,**52**]. The latter Swiss report had approximately double the aphids in conventional chemical plots, despite use of insecticides. Likely reasons for higher pest levels are because organic plants are more resilient to attack and disease; pesticides differentially kill pest predators; plus the more rapidly reproducing insect pest species soon develop resistance. Heaton (2001) [**53**] similarly concurred that: "Crop losses due to insects have increased by around 20 per cent since 1945 despite a 3,300 per cent increase in the amount of pesticides used." This is restated as "While insecticide use increased tenfold since the 1940s, crop losses to insects doubled" (Soule & Piper 1992: 46) [**54**]. Related to this issue is the discussion in Pimental (2005) [**55**]. Biocides are responsible for both benign or beneficial insect (and earthworm) declines.*"

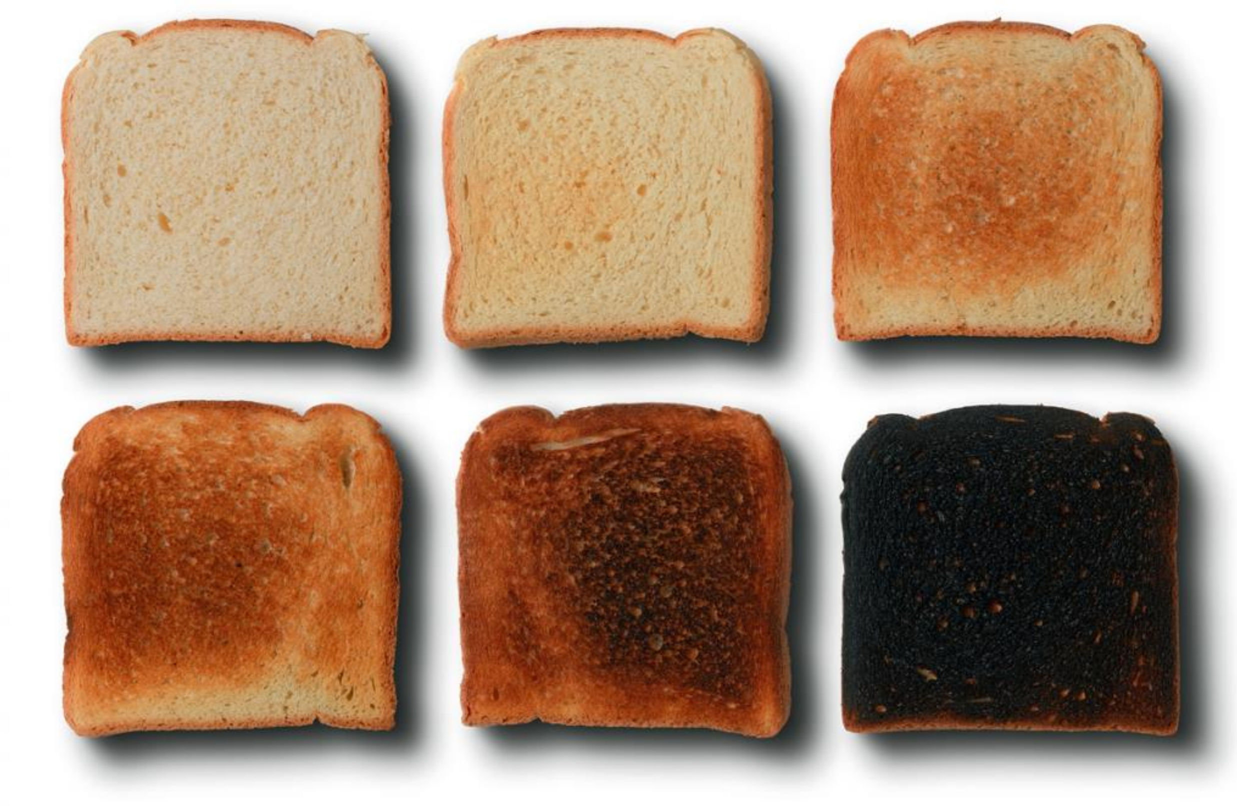
Rothamsted's Broadbalk experiment has clearly failed whilst also demonstrating many of the disbenefits of chemicals. It is important too to realize that the so-called organic treatments at Rothamsted are pitiful compared to proper 100% organic management with well-formed composts (avoiding toxic manures), good SOC, earthworm-rich soils, high biodiversity (think worms, insects, birds, & bats too – **Ref**.) and, most importantly, healthy food & livestock. As for livestock, earthworms increase farm yields 25% (**Ref**.) and Woolny (**1890**: 381) had grains or straw often doubled with worms. Why doesn't Rothamsted spend $2 million researching that? Is it because worms are unpatentable and work for free? Organic farm soils readily benefits from soil mixing by worms as my figure shows (note too the plant growth differences).

1 - No worms **2 - 4 *P. corethrurus* added 3 months before**

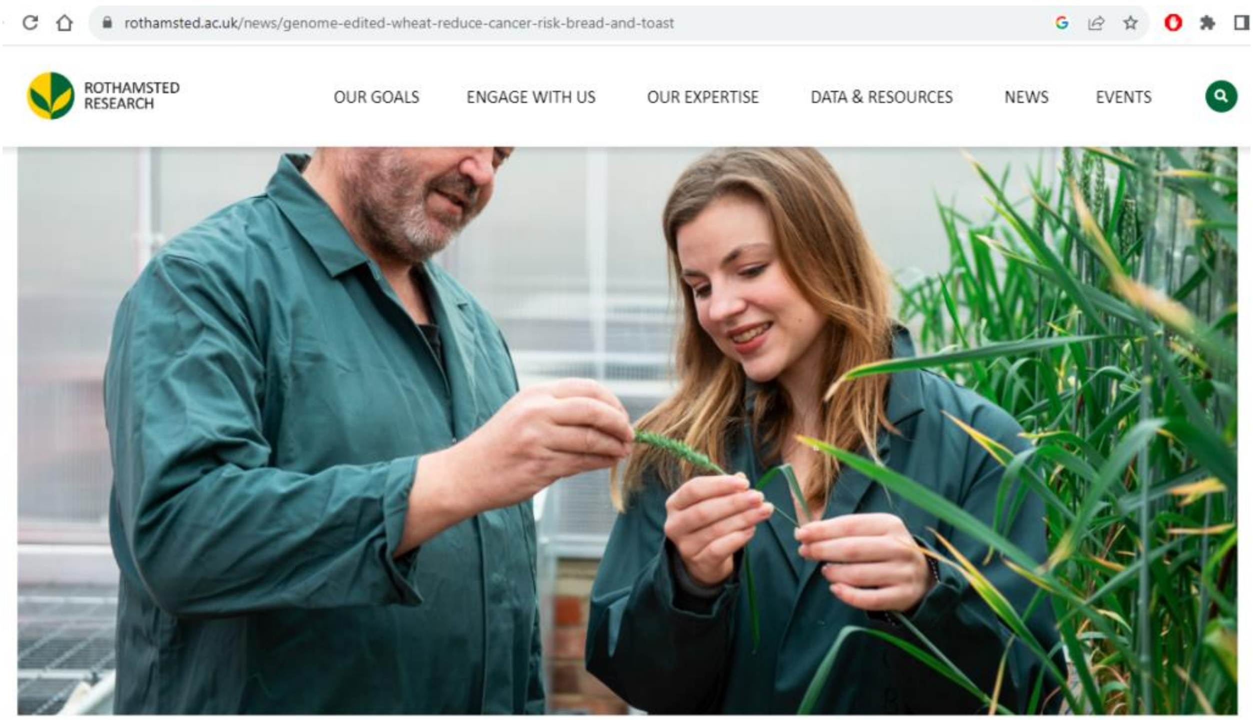
A - Two *Sorghum bicolor* 2 weeks before B - Cane trash litter C - Sandy-clay-loam D - Krasnozem

Courtesy of Dr Les Robertson BSES Tully, Qld Australia

If you destroy the earthworms – as chemical farming certainly does – then all the benefits of their activities and synergies with plants and soil microbes are lost. No chemical can substitute for the myriad earthworm effects as in my figure above. The Italian bat survey is another nail chemical farming's coffin with bat activity mainly (74.8%) in organic plots, undoubtedly due to the higher insect activity. This is likely also why Rothamsted's >$2 million GMO wheat trial failed in **2015**. Rather childishly, they input genes into wheat to simulate defence hormone to aphids in the vain hope predatory wasps would come save the day. The message may have been sent but since agrichemicals have destroyed most insects (along with the worms) few are left to answer the call. As if that was not enough of a ridiculous waste of funds & talent, their latest GMO plot was designed for those who don't know how to operate a toaster…



Their justification is that burnt toast has acrylamide and "*Acrylamide is classed as a probable carcinogen by the International Agency for Research on Cancer*" (**Ref.**). This is hypocritical, or inconsistent at least, since **Rothamsted also promotes glyphosate** herbicide [actually a biocide patented as an antimicrobial agent (**Ref.**) that damages or destroys our essential mitochondria (**Ref.**) which alone should for a sure enough reason for it to be restricted if not outright banned] that, similarly, "*The International Agency for Research on Cancer (IARC) has classified glyphosate as probably carcinogenic to humans (Group 2A)*." This potential patenting of genes is dangerous and unwarranted, not least by the precautionary principal. What if their new wheat actually causes cancer or poisons the environment? For what benefit? And isn't it theft to take all the historical legacy of farmers improving and selecting beneficial traits over generations in their heritage seeds perfectly adapted to each particular climate and soil. The GMO mentality is that one-size fits all and that the soil is immaterial when agrichemicals are used. A recent reference (**Ref.**) clearly states: "***Do you or any of the companies involved own patents on the technology?*** *No. CRISPR patents are held by two consortia*.." yet there are patents by those involved and explicitly these GM wheat trials are state by Rothamsted to be "*RELATED OUTPUTS*" of their patents (**Ref.**). Unsurprisingly, the study was also funded by Syngenta (**Ref.**)…

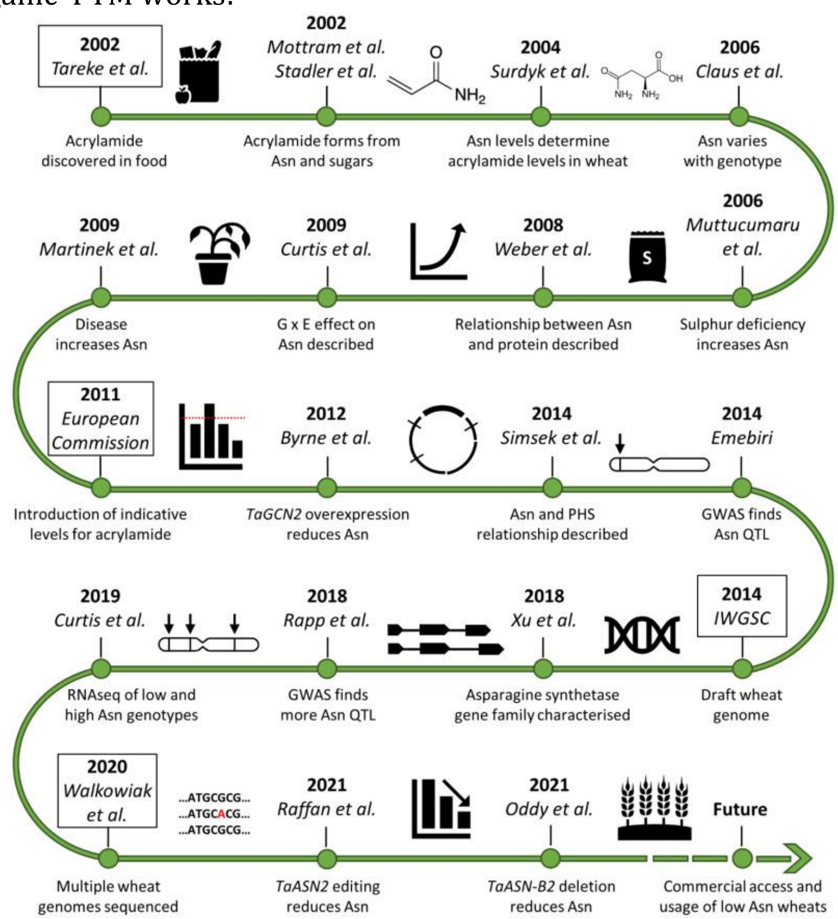


These serious concerns have led Raffan, Halford and colleagues to attempt to produce low asparagine wheat using genome editing.

As for safety? They promise they took precautions – "*Rothamsted states that cross-pollination with local wild plants or crops is 'extremely unlikely to occur' and that 'the trial site will be surrounded by a 3 metre-wide wheat pollen barrier and no cereals or grasses will be allowed to grow within 20 metres of the trial'*" (**Ref**., **Ref**.). How is that 3 m buffer responsible when transgene wheat pollen "*dispersed over distances greater than 245 m*" (**Ref**.), maize pollen can travel 4.45 km (**Ref**.), and pollen in the atmosphere is modelled at altitudes of 12 km (**Ref**.)? Albeit vitality is lost after about an hour (**Ref**.), what about the transfer between fields and nearby roads by wind or from tractors as in the photo below? So if it has drifted more than 3 m and cross-fertilized, forever and wherever, what is the precautionary plan then on how to retrieve it? None?

A

The other obvious question is what about the level of these toxins in truly organic grains? Three recent studies, Stockman et al. (**2018**), Stockman et al. (**2019a** & **2019b**) found: "*The* *impact of the management system on individual cultivars was obvious with a maximum reduction in free Asn* [precursor to Acrylamide] *contents of 50% in wheat cultivars if organically produced*". This elicited an instant response by Oddy et al. (**2020**) (funded by a combination of state & private industry, including Syngenta) that admitted "*nitrogen fertiliser is known to increase grain asparagine levels*" and that "*organic methods have been shown to achieve lower asparagine levels than conventional farming*". So why persist with costly chemical & GMO experiments? Stockman et al.'s (**2019a**) found "*With an appropriate choice of the cultivar, a reduction of up to 65% was possible within wheat, along with a reduction of 44% within spelt and 12.5% within rye. In summary, the results indicated that organically produced wheat especially offers the opportunity to significantly lower the AA potential of bread and bread rolls by the choice of raw materials low in free Asn*." The optimum organic growing techniques were refined in a subsequent paper (Stockman et al., **2019b**). Thus, organic wheat precludes the need for any costly and risky, synthetic-genetic tricky. With remarkable scientific impropriety, the Rothamsted promoters of CRISPR GMO wheat totally ignore these organic finding (e.g., 2021 **Ref**., 2022 **Ref**., 2923 **Ref**., 2023 **Ref**.) they yet persist with their folly regardless. The truth remains that Organic farming provided healthy food for millennia, as indeed it does today, without destroying soil, despite Rothamsted often sowing manipulated seeds of doubt. They always repeat a false mantra that 'organic has lower yields', further ignoring their trials clearly prove that 'organic' FYM works!



A summary graphic (**2022**) shows that Acrylamide was only discovered 20 years ago, and wheat genomes only drafted from ten years ago, yet it totally **ignores Stockman et al**. finding that organic wheat is safer..

Shoddy work demonstrates how honest Science has lost its direction and supports an earlier contention: "*a 'knowledge erosion'[6] took place, partly driven by an intermingling of economics and research.[7]*" (**Ref**.).

As for biocides, Rothamsted has gone so far as to claim toxic, carcinogenic glyphosate is actually beneficial to worms and to soil fungi (**Ref**. cf. **Ref**.). You are welcome to find many references rebuking this claim, (eg. **Ref**., **Ref**., **Ref**., **Ref**. etc.). Note too that this is the same Rothamsted chemist who publicly and personally (**Ref**.) attacked and criticized my earthworm summary after 40 yrs of my agroecological, earthworm research (**Ref**.) of which part was based on Rothamsted's **own data** (e.g. by Morris 1922, 1927; Edwards & Lofty 1982, and Sizmur et al. 2017 as I clearly state in the figure above)! Dumb chemists are paid to spread misinformation for yet more chemical poisons rather than admit the truth of organic soils and foods being richer & healthier… Farmers who appreciate soils should kick chemists off of their fields.

It is not just me saying this. Here a summary of just some toxicity problems with glyphosate (**Ref**.): "*Resulting from its accumulation and persistence in the soil, glyphosate can affect exposed organisms in this environmental compartment [**44**]. For example, it has been reported that glyphosate can affect the activity of soil microorganisms that are involved in biogeochemical cycles, the mineralization of organic remains, the immobilization and solubilization of minerals, and the degradation of other xenobiotics [**45**,**46**,**47**]. Likewise, **a reduction in the reproduction rate, biomass, and DNA damage in earthworms has been reported** [**48**,**49**,**50**], as well as adverse effects in other small size organisms, such as nematodes, distributed in soils [**51**]. Moreover, in plant species, the direct effects of their exposure to glyphosate are related to the inhibition of the activity of antioxidant enzymes and the induction of reactive oxygen species (ROS), which promote cell damage and physiological alterations in processes such as photosynthesis and the production of secondary metabolites [**52**]. Furthermore, traces of this compound can be detected in plant tissues of temperate zone species up to more than 12 years after the treatment [**4**]. **Glyphosate indirectly changes the rhizosphere microbiome, which affects plant health** [**28**,**53**]*." Also "*Similarly, unwanted effects of glyphosate exposure have been reported in **bee species that provide valuable ecosystem services such as pollination** [**59**]. Finally, glyphosate has been detected in animal feed, animal meat, and urine, as well as in the food intended for human consumption, which is why the presence of this herbicide has been detected in samples of breast milk and urine [**5**]. Another additional environmental risk associated with the presence of glyphosate, which has not been adequately considered, is that it is **a potent mineral chelato**r [**18**] whose application can lead to the reduction of macro and micronutrients that are essential cofactors in many biological processes of glyphosate-treated plants and potentially also for the organisms that feed on them. Consequently, a reduced supply of nutrients in the treated plants can compromise their resistance to diseases. I**n the case of humans and other animals that consume food obtained from plants treated with glyphosate, the residues of this herbicide and the reduced levels of nutrients can also have an impact on their health** [**18**,**60**]. Therefore, to minimize its environmental and human health impacts, monitoring and detection of its presence in different environments, as well as the evaluation of exposure to this herbicide in humans, is of utmost importance*."

Back to yields… Rothamsted Hoosfield's spring barley (as used for beer) has similar results to Broadbalk's winter wheat as organic FYM consistently outperforms chemical NPK (probably also destroying the soil):

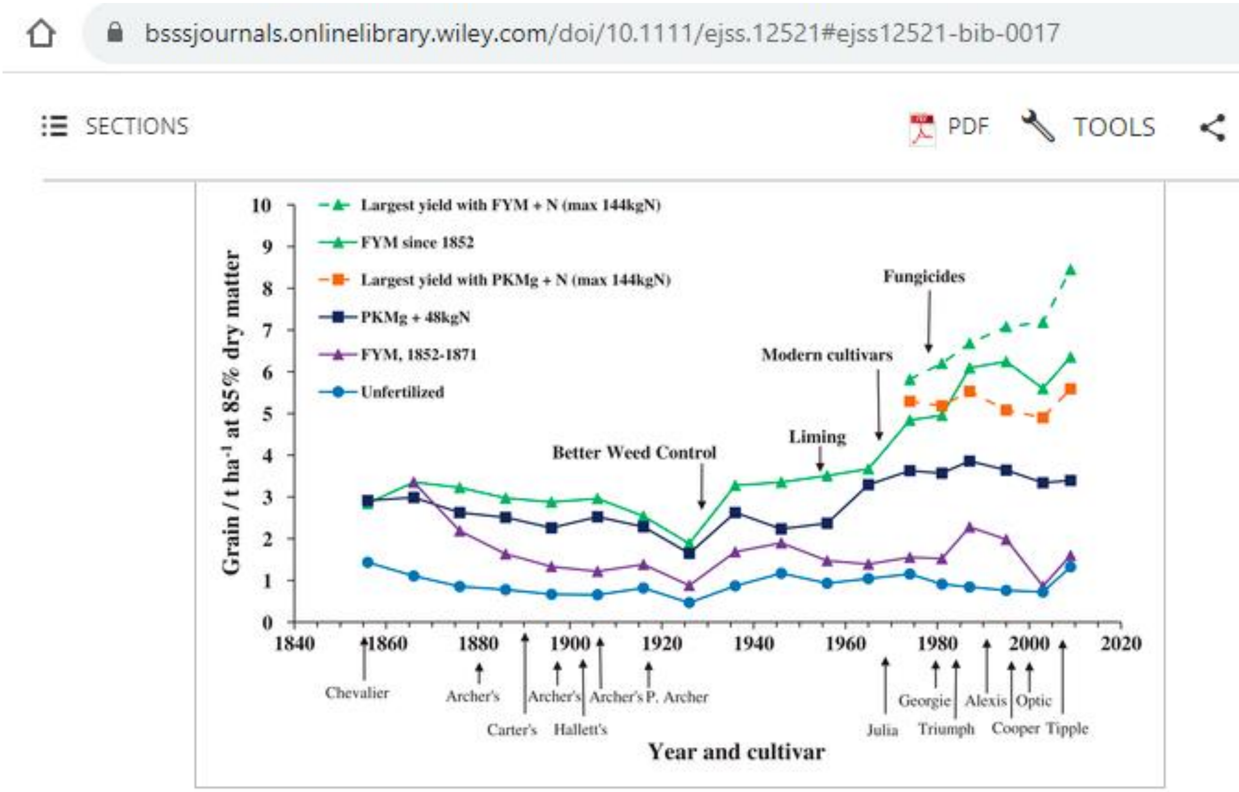
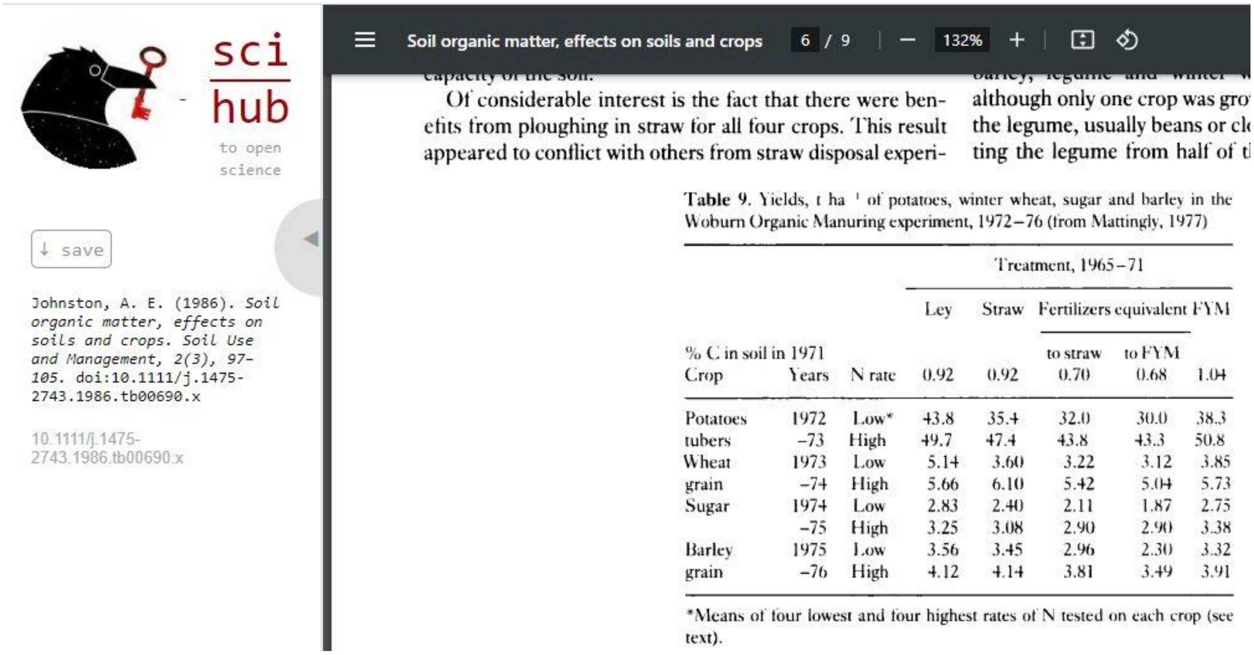


Figure 2 Open in figure viewer | PowerPoint

Mean long-term yields of spring barley grain, 1852–2015, showing selected treatments, important changes in management and cultivars grown. Hoosfield Spring Barley experiment, Rothamsted.

Similar results were seen in other crops at Woburn site that started about the same time as Rothamsted:



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Johnston, A. E. (1986). *Soil organic matter, effects on soils and crops. Soil Use and Management, 2(3),* 97–105. doi:10.1111/j.1475-2743.1986.tb00690.x

10.1111/j.1475-2743.1986.tb00690.x

Soil organic matter, effects on soils and crops 6 / 9 132%

capacity of the soil.

Of considerable interest is the fact that there were benefits from ploughing in straw for all four crops. This result appeared to conflict with others from straw disposal experi-

barley, legume and winter w… although only one crop was gro… the legume, usually beans or cl… ting the legume from half of t…

Table 9. Yields, t ha⁻¹ of potatoes, winter wheat, sugar and barley in the Woburn Organic Manuring experiment, 1972–76 (from Mattingly, 1977)

			Treatment, 1965–71				
			Ley	Straw	Fertilizers equivalent		FYM
% C in soil in 1971					to straw	to FYM	
Crop	Years	N rate	0.92	0.92	0.70	0.68	1.04
Potatoes	1972	Low*	43.8	35.4	32.0	30.0	38.3
tubers	–73	High	49.7	47.4	43.8	43.3	50.8
Wheat	1973	Low	5.14	3.60	3.22	3.12	3.85
grain	–74	High	5.66	6.10	5.42	5.04	5.73
Sugar	1974	Low	2.83	2.40	2.11	1.87	2.75
	–75	High	3.25	3.08	2.90	2.90	3.38
Barley	1975	Low	3.56	3.45	2.96	2.30	3.32
grain	–76	High	4.12	4.14	3.81	3.49	3.91

*Means of four lowest and four highest rates of N tested on each crop (see text).

The FYM yields are in the last column compared to the NPK equivalents showing all FYM yields higher. Other non-grain crops also have higher yields, e.g. the potatoes with FYM compared to NPK at Woburn.

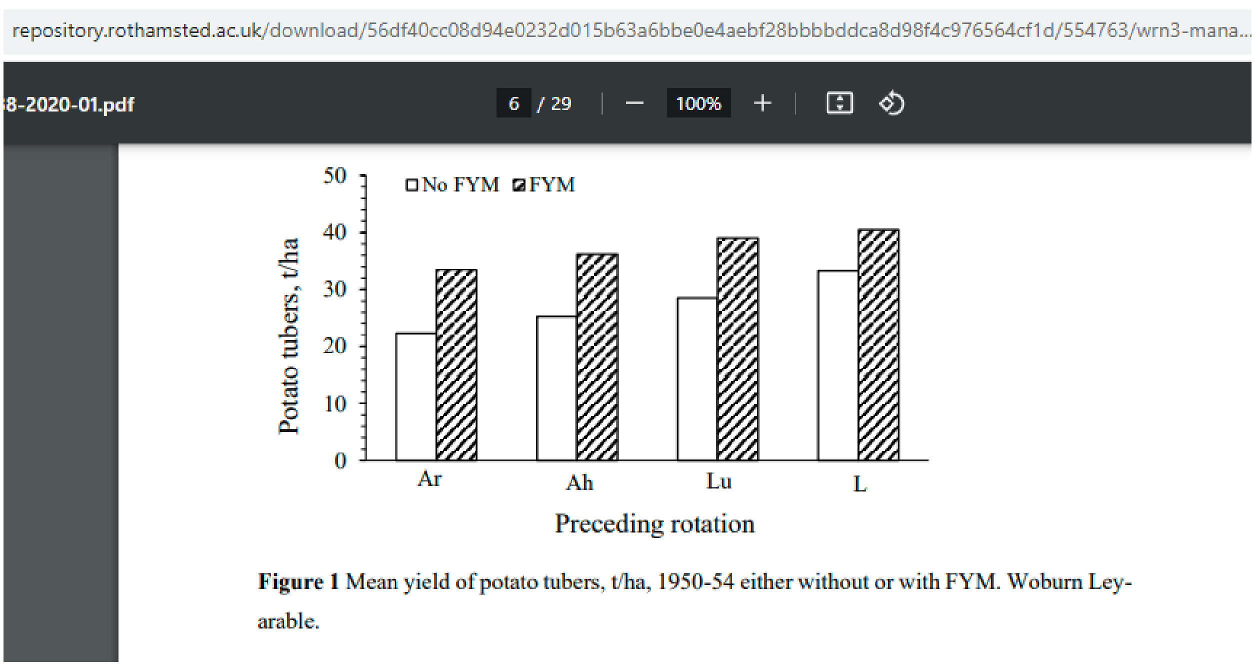

Figure 1 Mean yield of potato tubers, t/ha, 1950-54 either without or with FYM. Woburn Ley-arable.

Here are the earliest yields from Broadbalk from 1844 with FYM plots much higher from the start.

Report of Experiments on the Growth of Wheat for Twenty Years in Succession ...

By John Bennet Lawes, Joseph Henry Gilbert

Lawes, J. B. Go

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With these characters of season, which proved extremely adverse to grass and spring-sown crops, the wheat-crop was reported to be generally well got in, and to be one of the largest in bulk and yield for many years past.

The amount and character of the produce obtained in the experimental field is sufficiently indicated by the following summary of the results yielded on some of the most important plots :—

TABLE I.—SUMMARY of the Results of the FIRST SEASON, 1843-4.

MANURES. (Quantities per Acre.)	PRODUCE PER ACRE, &c.				
	Dressed Corn.			Total Corn.	Straw and Chaff.
	Quantity.		Weight per Bushel.		
	Bush.	Pks.	lbs.	lbs.	lbs.
Unmanured (Plot 3)	15	0	58·5	923	1120
14 tons Farmyard Manure (Plot 2)	20	1¾	59·3	1276	1476
Ashes of 14 tons Farmyard Manure (Plot 4) ..	14	2¼	58·0	888	1104
Mixed Mineral Manure alone; mean of 9 plots (5, 6, 7, 8, 10, 12, 13, 14, and 15)	15	2¾	61·0	1009	1155
Mixed Mineral Manure, and 65 lbs. Sulphate of Ammonia; mean of 3 plots (9, 16, and 17) ..	19	1¾	62·3	1275	1423
Mixed Mineral Manure, and 80 lbs. Sulphate of Ammonia (Plot 19)	24	1¼	61·8	1580	1772

Lawes, J. B.

TABLE XXII.—ANNUAL AVERAGE PRODUCE, &c., over the First half, the Second half, and the Total periods of the application of different Manures, each Year after Year on the same Land.

Plot		AVERAGE ANNUAL.			Duration of Total Period.
		First half of Period.	Second half of Period.	Total Period.	
	Dressed Corn, per Acre, in Bushels and Pecks.				
3	Unmanured, every year	15 3¼	16 2½	16 1	20 years—1844-1863.
10a	Ammonia-salts alone, every year	24 3¾	23 3¾	24 1¾	19 years—1845-1863.
2	14 tons Farmyard Manure, every year	27 0½	37 3¼	32 1¾	20 years—1844-1863.
3	Unmanured, every year	15 1¼	15 2	15 2	12 years—1852-1863.
5	Mixed Mineral Manure alone, every year	18 3¼	18 0¼	18 1¾	
10a	Ammonia-salts alone, every year	23 1	22 0	22 2½	
7	Ammonia-salts and Mixed Mineral Manure, every year	35 0½	37 2½	36 1½	
2	14 tons Farmyard Manure, every year	33 1¼	37 1¾	35 1½	
	Weight per Bushel of Dressed Corn, in lbs.				
3	Unmanured, every year	58·3	57·6	57·9	20 years—1844-1863.
10a	Ammonia-salts alone, every year	58·7	56·6	57·6	19 years—1845-1863.
2	14 tons Farmyard Manure, every year	59·8	60·3	60·0	20 years—1844-1863.
3	Unmanured, every year	55·8	57·2	56·5	12 years—1852-1863.
5	Mixed Mineral Manure alone, every year	57·1	58·7	57·9	
10a	Ammonia-salts alone, every year	55·9	55·8	55·9	
7	Ammonia-salts and Mixed Mineral Manure, every year	57·9	58·9	58·4	
2	14 tons Farmyard Manure, every year	58·8	59·8	59·3	
	Total Corn, per Acre, in lbs.				
3	Unmanured, every year	1018	1035	1026	20 years—1844-1863.
10a	Ammonia-salts alone, every year	1628	1527	1575	19 years—1845-1863.
2	14 tons Farmyard Manure, every year	1757	2395	2076	20 years—1844-1863.
3	Unmanured, every year	963	965	964	12 years—1852-1863.
5	Mixed Mineral Manure alone, every year	1171	1144	1157	
10a	Ammonia-salts alone, every year	1463	1408	1435	
7	Ammonia-salts and Mixed Mineral Manure, every year	2195	2356	2275	
2	14 tons Farmyard Manure, every year	2102	2362	2232	
	Total Straw (and Chaff), per Acre, in lbs.				

And so on… Thus my argument stands that Rothamsted has run its chemical course, needs to admit defeat, and redirect itself to trying to save our soils and vital soil biota (as well as bats, birds & bees, etc.).

This is an afternote, a postscript if you like, but it seems to me quite important. As a field ecologist – not a lab based reductionist and certainly not a philosophical idealist (although I am a proper **Ph.D.**) – my knowledge and information are earned from practical, on-the-ground, facts (literally). No woo here. And although it is not my ‘wheel-house’ as I work mainly on worms, the insect or bird people say their study subjects are being obliterated, just as my worms are. So here is the issue: If, in real-time, bats are being unannihilated in all but organic farms, as the Italian study indicates (**Ref**.), then we do not need to rely on historical data. **THIS IS HAPPENING NOW ON OUR WATCH!** Sorry to shout but, really, come on guys. Bat workers used sonics to gage activity. A silence over chemical fields is a death knell for chemical farming. Rachel Carson told us this 60 years ago with *Silent Spring.* Don’t believe me, nor insect, bat or bird guys. Go out yourself to sample organic vs. chemical fields. Q.E.D.