

Is Paraquat Useful for the Environment?

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According to Syngenta's marketing website about paraquat this total herbicide is not only safe to use but actually provides added benefits for the environment. In particular, we are told, so-called paraquat-farming prevents erosion. We also get the impression that conservation tillage or no-tillage are only possible in combination with paraquat.¹

Here's a quote from the site:

„These benefits to the environment include:

Improved soil fertility: Paraquat's contact-only action allows farmers to control only weeds without killing the root structure, making it an ideal herbicide for use in conservation and no-till systems.

Field studies have shown that no-till systems using paraquat:

- increase organic matter
- reduce carbon dioxide emissions by allowing the soil to act as a better carbon sink
- have higher microbial populations and surface microarthropods
- have higher earthworm populations (...).“

Paraquat's alleged usefulness for the environment is thus limited to conservation tillage or direct seeding systems.

When the author inquired about the two field studies mentioned on the site the web publisher sent him two publications supported by Syngenta²: „Paraquat and sustainable agriculture“ by R.H. Bromilow (2003)³ and „Deactivation of the Biological Activity of Paraquat in the Soil Environment: a Review of Long-Term Environmental Fate“ by Roberts et al. (2002)⁴.

Both studies describe that the above mentioned positive effects can be attained through conservation tillage and direct seeding and that paraquat eased transition to conservation agriculture and no-tillage in the past. However, neither study actually states that any positive effects were directly caused or augmented by paraquat.

Authors Bromilow and Roberts et al. claim that paraquat helped get the idea of conservation agriculture and no-tillage accepted in Europe and the USA in the 1960s. But they fail to mention that any comparable total herbicide would have had the same effect – such as the glyphosate-based Roundup⁵, which is commonly used today but only came on the market in the mid-70s.

¹ <http://www.paraquat.com/BenefitsofParaquat/Totheenvironment/tabid/136/Default.aspx>
Accessed on 13.09.06

² e-mail from contact@paraquat.com of 24.08.06 to the author

³ Bromilow (2003): Paraquat and sustainable agriculture, Pest Manag Sci 60:340 – 349, Society of Chemical Industry

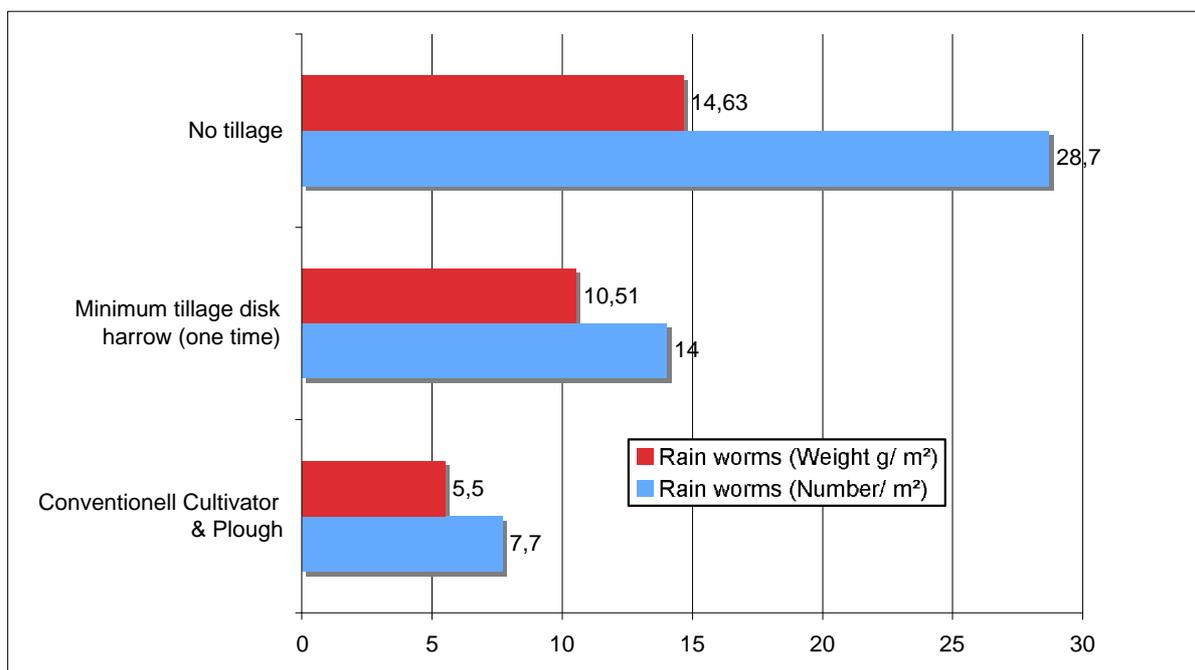
⁴ Roberts et al (2002): T. R. Roberts, J. S. Dyson, M. C. G. Lane; Deactivation of the Biological Activity of Paraquat in the Soil Environment: a Review of Long-Term Environmental Fate, J. Agric. Food Chern. 2002, 50, 3623-363, American Chemical Society
Published on Web 05/18/2002

⁵ Roundup is synonymously used here for the following products: Roundup, Roundup TURBO, Roundup Ultra und RoundupUltraMax.

No one doubts that conservation tillage and no-tillage have positive effects on the life of the soil and limit erosion. But paraquat is not needed to achieve these results. Here's why:

1. The positive effects of conservation tillage and no-tillage are mostly due to the fact that fields are not ploughed and the topsoil is permanently covered with organic plant material (mulch). Ploughing seriously disrupts the soil and it is a known fact that earthworm populations grow as cultivation intensity decreases. Mulch enriches the topsoil and promotes microbial activity. The overall stability of soil aggregates is increased; siltation and erosion are greatly limited.⁶

The figure below shows the influence of soil cultivation on earthworm populations.



Source: Rosner et al. 2006

Figure 1 Number and weight of earthworms after an 11-year comparative trial (arable production) between different soil cultivation intensities at 2 locations in Austria (measured in 2004 and 2005)

The numbers in Figure1 are the results of an 11-year trial on Austrian farmland threatened by erosion. They show that erosion can be reduced dramatically by conservation tillage or direct seeding⁷ – without paraquat, which is banned in Austria since 1992.⁸

⁶ K. Köller & Ch. Linke (2001): Erfolgreicher Ackerbau ohne Pflug, Wissenschaftliche Ergebnisse – Praktische Erfahrungen, DLG Verlag, Frankfurt am Main

⁷ Rosner et al (2006): J. Rosner, E. Zwatz, A. Klik C. Gyuricza, Konservierende Bodenbearbeitungssysteme – Boden – Nährstoff – und Pestizidabträge, Hrsg: Amt der Niederösterreichischen Landesregierung, Abt. Landwirtschaftliche Bildung, Frauentorgasse 72, A - 3430 Tulln

⁸ Information from Matthias Lentsch, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Österreich, e-mail vom 05.07.2006

Tab. 1 Actual annual erosion and yields 1994 – 2004 in a trial (arable production) to compare different intensities of soil cultivation at various locations in Austria.

Parameter	Cultivation method		
	Conventional	Conservation tillage	Direct seeding
Soil loss from erosion t/ha/year	16,2	4,2	2,2
N-loss kg/ha/year	23	8	4,5
P-loss kg/ha/year	13,8	3,2	1,9
Herbicide degradation in % of applied amount of active ingredient	1,9	1,2	0,5
Yield in % of conventional 1994 - 2004	100	100	101

Source: Rosner et al. 2006

The preservation of the living root structure that Syngenta underlines in its sales pitch for paraquat probably plays a very minor role in limiting erosion when compared to the benefits of not ploughing and protecting the topsoil with a permanent plant cover. None of the studies quoted by Syngenta prove this effect. Besides, any network of roots stabilizes to the soil to some extent – whether or not the roots are alive probably makes very little difference.

2. Paraquat is a total herbicide that only kills plant parts containing chlorophyll on contact. The underground parts of the plant are not affected. In this respect the effect of paraquat can be compared to mowing or slash weeding when the mowed plants are left on the field as mulch. Mowing and slash weeding also leave the root structure intact. The presumed environmental benefit of paraquat (preserving the living root structure) could thus be achieved with considerably less risk for the users and the environment.

In a six-year trial to compare different weed management systems in the tea production on Sri Lanka all manual methods prevailed over all chemical variants, including paraquat, in terms of yield and environmental impact. Slash weeding without removing the cut plants was particularly effective – yields were higher than with paraquat alone, with a lower treatment frequency (25% on average) and a 50% higher earthworm population.⁹ How the publishers of Syngenta's paraquat Website manage to spin these results into a triumph for paraquat remains a mystery.

Treatment with paraquat is not an effective remedy against perennial root weeds like thistles, couch grass, and bearbind – on the contrary, depending on the date of treatment paraquat may inadvertently give them a boost since it kills the competition and allows these weeds to tiller more easily. The use of paraquat is thus by no means „ideal“ for conservation tillage or no-tillage but may in fact require the application of other weed control methods.

3. The use of paraquat may have eased the introduction of conservation agriculture and no-tillage in North America and Europe. But in the meantime paraquat has largely been displaced from these cultivation systems by systemic herbicides like Roundup, which contain glyphosate. Conservation tillage and direct seeding are doing just fine without paraquat. Some examples will illustrate this.

⁹ P. B. Ekanayake , K. G. Prematilaka & A.P.D.A. Jayasekara (2005): Impact of some weed management strategies on the productivity of tea plantations in Sri Lanka, in Proceedings, The 20th Asian-Pacific Weed Science Society Conference, 7.-11. November, 2005, Ho Chi Minh City, Agriculture Publishing House, Ho Chi Minh City

About 90% of all US-farmland is cultivated without ploughs. The share of conservation tillage is 40% while no-tillage accounts for about 20%.¹⁰

The US-Department of Agriculture (USDA) keeps records of pesticide use in 34-39 states, including all the leading agricultural states.

The table below shows the use of some major herbicides and paraquat on crops in 34 US-states in 2004 (corn, total 2003)¹¹.

Tab. 2 Use of selected herbicides and paraquat on crops in 34 US-states in 2004 (corn, total & cotton 2003)

	Use of active ingredient in 1000 kg						
	Paraquat	Atrazin	Glyphosat	2,4-D	MCPA	Trifluralin	Pendimethalin
Soybean	52	0	26.173	350	0	1.220	944
Corn-Sweet	1	162	15	1	0	0	19
Peanuts	35	0	85	17	0	11	193
Wheat-Winter	0	101	1.655	986	226	0	0
Wheat-Other Spring	0	0	705	488	38	22	0
Corn, all (2003)	173	25.239	5.404	666	0	34	783
Cotton (2003)	290	0	5.731	171	0	1.885	822

Quelle: National Agricultural Statistical Service (NASS)

The table clearly shows that paraquat use is marginal on major crops in the US.

In many European countries (e.g. Hungary¹², Slovenia¹³, Lithuania¹⁴, Sweden¹⁵, Denmark¹⁶, Austria, Latvia¹⁷, Estonia¹⁸ and Switzerland¹⁹), the use of paraquat is banned or restricted (Germany, Poland).

It would be foolish to assume that conservation agriculture does not exist in these countries just because paraquat is out. In Austria's vineyards conservation tillage is everywhere and many younger farmers on larger farms cultivate some 50-70% of their farmland without a plough.²⁰

According to the European Conservation Agriculture Federation (ECAAF) Switzerland is the European leader with 40% conservation agriculture and 3% direct seeding – and no paraquat used whatsoever.

¹⁰ K. Köller & Ch. Linke (2001): Erfolgreicher Ackerbau ohne Pflug, Wissenschaftliche Ergebnisse – Praktische Erfahrungen, DLG Verlag, Frankfurt am Main

¹¹ Online Datenbank: Agricultural Chemical Use Database des National Agricultural Statistical Service (NASS), http://www.pestmanagement.info/nass/app_usage.cfm, Search: 14.09.06

¹² List of authorised pesticides: <http://www.neoland.hu/> Search: 27.09.06

¹³ Information from Milena Koprivnikar, Ministry of Agriculture, Forestry and Food Administration for Plant Protection and Seeds, Slowenien, e-mail 05.07.2006

¹⁴ Personal message from Kristina Valionienė, State Plant Protection Service Plant Protection Division, Litauen, e-mail 12.07.2006

¹⁵ Personal message Lilian Törnqvist, Kemikalieinspektionen (National Chemicals Inspectorate), Schweden, e-mail 06.07.2006

¹⁶ Personal message Nina Sørup Hansen, Danish Environmental Protection Agency, Pesticides Division, Dänemark, e-mail 05.07.2006

¹⁷ Personal message Inese Margeviča, Ministry of Agriculture Republic of Latvia, State Plant Protection Service Plant Protection Department, Lettland, e-mail 05.07.2006

¹⁸ Personal message , Plant Protection Department, Estonian Plant Production Inspectorate, Estland, e-mail 05.07.2006

¹⁹ Web site of the Federal Office of Agriculture (Switzerland) List of herbicides on www.blw.admin.ch.

²⁰ personal message from Dipl. Ing. Dr. Josef Rosner, Niederösterreichischen Landesregierung, e-mail from 7.7.06

Germany is in second place with 20-25% of its farmland under conservation tillage or no-tillage.²¹ Paraquat use is absolutely marginal here. In the cultivation of grain and rape seed it may not be used.²² Overall use of paraquat is negligible. While Glyphosate sold in quantities over 1000 tons annually between 2003 and 2005, all of 10-25 tons of paraquat were sold in 2004 and only 2.5-10 tons in 2005.²³

This is the proper background for Syngenta's marketing website. Paraquat's role on the pesticide markets in the US and in Europe is trifling and the web site is merely an attempt to polish the image of paraquat and hype its alleged advantages over glyphosate. Much the same goes for the Syngenta-funded research to limit erosion.

Paraquat research – a typical case of a „false dilemma“

A false dilemma is a rhetorical device that declares a decision between two options as a necessity, thus suggesting a dilemma although in reality other options exist. The two alternatives presented are often the two extreme points on some spectrum whereas the alternative in the middle is suppressed.²⁴

The authors of Syngenta's paraquat website claim that paraquat prevents erosion because the root structure of the treated plants is not killed. For more information the reader is referred to the pages www.proterra.eu.com and www.sowap.org .

ProTerra (© Syngenta) presents itself as an online resource for soil protection in Mediterranean olives and vines. Its authors argue that a vegetative cover between the crop rows limits erosion on steep slopes.

That a durable plant cover limits erosion is beyond dispute. But the web page provides no evidence to support its claim that paraquat in particular limits erosion.

The method of the project sheds light on its object: „Field trials have been installed in France, Italy, Portugal and Spain. Generally, the approaches tested are based on the use of non-selective herbicides (e.g. glyphosate and paraquat) to manage vegetative soil cover between crop rows; the vegetative cover consisting of either deliberately sown vegetation or naturally occurring weeds.“²⁵

Non-chemical alternatives such as mowing, pasturing (in olive cultures) or light mechanical cultivation (flex-tine weeder) are not part of the project. By suppressing these alternatives Syngenta researchers create a „false dilemma“ and subvert the credibility of their work.

By the same token the use of the predicate „sustainable“ in connection with paraquat is problematic. The Pro Terra Project fails to mention that paraquat may not be used under the internationally recognized rules of integrated production (see below).

²¹ Web page of the European Conservation Agriculture Federation (ECAAF) <http://www.ecaf.org/Situation.htm>, Accessed on 15.09.06

²² Swiss Federal Office for Consumer Protection and Food Safety (BVL): Online database: list of approved herbicides, accessed on 15.09.06

²³ Swiss Federal Office for Consumer Protection and Food Safety (BVL): sales of herbicides in Germany based on results of declarations according to § 19 plant protection law for 2005, 2004 and 2003

²⁴ Definition after www.wikipedia.de

²⁵ ProTerra Web page <http://www.proterra.eu.com/> Zugriff am 14.09.06

Nor do the initial results on the SOWAP website provide any evidence for the special effectiveness of paraquat in limiting soil erosion, beyond the decades-old assertion that „conservation tillage techniques have reduced soil loss and water run-off from fields compared to ploughing in all 3 SOWAP countries (Belgium, UK, Hungary). On some of the conservation-tilled field plots, soil erosion has been reduced by up to 90% and water run-off by up to 40%.“²⁶

Paraquat and integrated production

In chapter 24 („Promotion of sustainable agriculture and rural development“) the United Nations' Agenda 21 for Sustainable Development has this to say about the future of herbicides:

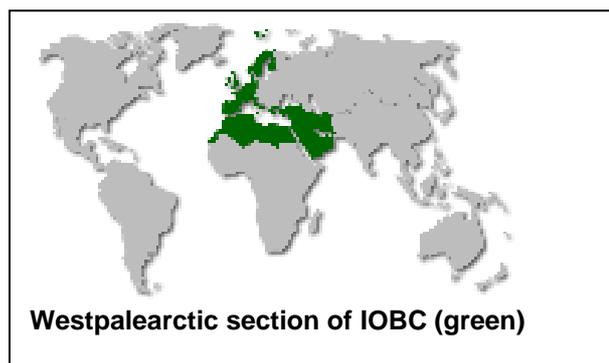
„Integrated pest management, which combines biological control, host plant resistance and appropriate farming practices and minimizes the use of pesticides, is the best option for the future, as it guarantees yields, reduces costs, is environmentally friendly and contributes to the sustainability of agriculture.“²⁷

As of January 1, 2014 pesticide use in the European Union (EU) will be subject to a set of principles for integrated plant protection.²⁸ The actual principles have not yet been developed. The „International Organisation of Integrated and Biological Control of Noxious Animals and Plants“ (IOBC) is a global leader in the development and implementation of principles and guidelines of integrated production. The IOBC has been around for 50 years and is active in countless working groups on integrated production and biological plant protection around the world.

The IOBC-section in charge in South and West Europe and North Africa (IOBC-WPRS) is the westpaleartic section stretching from Sweden and Norway all the way to North Africa (see map).

IOBC-WPRS publishes and updates three different kinds of technical guidelines:

1. Technical guidelines I that define the legal status of IP-organizations producing under IOBC-standards and describe the minimum requirements for these organizations and their members.
2. Technical guidelines II include general agricultural rules and minimum requirements and define mandatory rules and prohibitions that all farmers are required to comply with. Technical guidelines II also contain recommendations for



²⁶ SOWAP Web page „Initial Results from SOWAP“: <http://www.sowap.org/comms/keymessages.htm>
> Soil Erosion >>View, accessed on 14.09.06

²⁷ UN Department of Economic and Social Affairs, Division for Sustainable Development
<http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21chapter14.htm> accessed on 14.09.06

²⁸ Commission of the European Union (2006): Proposal for a Regulation of the European Parliament and of the Council concerning the placing of plant protection products on the market (presented by the Commission), COM(2006) 388 final, Brüssel

optimal solutions beyond that which is mandatory.

3. Technical guidelines III for individual fruits.

The westpaleartic section of the IOBC (WPRS) has also published fruit-specific IP guidelines for pome fruits, stone fruits, field crops, grapes, olives, citrus fruits, field vegetables, berries and small fruits.

In the third edition from 2004 the technical guidelines II contain the following passage concerning weed management: „whenever possible, weed management should employ non-chemical methods“.²⁹

Regarding the use of pesticides the first edition from 1999 has this to say: „Unselective pesticides with long persistence, high volatility, leachable or with other major detrimental characteristics (e.g. stimulation of non-target pest organisms) are prohibited.“³⁰

The non-selective herbicide paraquat with a soil half-life of 7-20 years³¹ fell under this general prohibition and is still mentioned in the IP-guidelines for olives³², vines und small fruits and berries. Since 2004 IOBC-WPRS guidelines require that regional organizations interested in cultivating under IOBC-rules draw up a „green“ and a „yellow“ pesticide list. These lists take the place of general bans for specific pesticides formerly imposed by the IOBC-WPRS. In selecting pesticides for the „green“ list (admissible pesticides), however, farming associations now have to consider the following criteria:

- human toxicity,
- toxicity for beneficial organisms,
- toxicity for other natural organisms,
- potential for environmental contamination (soil, water, air),
- potential for promoting pests and diseases,
- selectivity,
- persistence,
- (potential for resistance development),
- incompleteness of information,
- necessity of application.

Under these criteria paraquat does not qualify for integrated production: it has a very high acute toxicity for mammals, is extremely persistent, non-selective, contaminates the soil and, last but not least, is not needed given the existence of non-chemical alternatives and less problematic herbicides.

²⁹ IOBC/WPRS Bulletin, Bulletin OILB/SROP Vol. 27 (2) 2004, Commission "IP-Guidelines and Endorsement" Integrated Production Principles and Technical Guidelines, 3rd Edition

³⁰ IOBC/WPRS Bulletin, Bulletin OILB/SROP Vol.22 (4) 1999, Commission "IP-Guidelines and Endorsement" Integrated Production Principles and Technical Guidelines

³¹ European Commission, Health and Consumer Protection Directorate-General, Directorate E – Food Safety: plant health, animal health and welfare, international questions (2003): Review report for the active substance paraquat, SANCO/10382/2002 –final, Brüssel

³² International Organisation for Biological and Integrated Control of Noxious Animals and Plants Guidelines for the integrated production of olives, IOBC Technical Guideline III, 2002, 1st Edition

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Because of its high human toxicity and persistence paraquat cannot even be included in the „yellow“ list of exceptions.

Conclusion

On Syngenta's paraquat website, and in other publications like the 2005 social and environmental report the company claims that paraquat has added benefits for the environment. These claims in no way hold up under scrutiny. Neither Syngenta's „in-house“ research nor current agricultural practices substantiate any such benefits for the environment. Without so much as mentioning alternative explanations, paraquat is given full credit for the positive effects of conservation agriculture and direct seeding that result from not ploughing and covering the soil with an organic mulch cover.

The fact is paraquat no longer has any economic importance in the agriculture of the USA and Europe. It has been squeezed out of the market almost completely by competing brands, in particular by herbicides containing glyphosate.

The website appears to be an attempt designed to improve the image of paraquat to keep or, more accurately, win back market share. Attempting to do so by pushing the argument of sustainability and „additional environmental benefits“ seems fairly bold considering how incompatible paraquat is with the requirements of integrated production which is seen as the global agricultural model of the future.

About the author

Lars Neumeister is an engineer (Dipl.-Ing. FH) for land use and conservation and works as an independent pesticide expert. For the past 8 years he has focused exclusively on the issue of pesticides, four of these years working as an independent expert. He is the author of over 30 brochures, studies, and articles about various topics relating to pesticides. He lives and works in Berlin and in the Uckermark.

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