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Global oil yields: Have we got it seriously wrong?

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Up to now, most oilseed crop specialists have assumed that one metric ton (MT) per hectare (1MT/ha) was a pretty good ballpark figure for average oil yields from annual oilseed crops such as canola or sunflower. Of course the precise figure varies somewhat depending on the crop variety, climatic zone, and agronomy. Hence, spring-sown canola has quoted yields of about 0.6 MT/ha of oil in the Canadian prairies, whereas high-input, autumn-sown canola/rapeseed varieties in milder European climates average something closer to 1.4 MT/ha. Soybean has lower seed oil content, but it still manages about 0.5–0.6 MT/ha. Hence, the globally averaged oil yield from temperate crops is generally quoted at more or less 1 MT/ha. Thanks to improved varieties and agronomic practices, these estimated yields have increased slightly over recent decades but have not strayed too far from that magic figure of 1 MT/ha (see Table 1).

Over the last five years or so, these estimates of global vegetable oil yields have been used to calculate the expected efficiency of biofuel crops, especially in the biodiesel sector. Oil yields are the key to life-cycle analysis calculations of the net carbon or energy gain (or loss) from producing fuels from crops, compared with conventional fossil-derived petroleum feedstocks. These sorts of analyses have recently caused concern in some quarters when it was claimed that bioethanol made from US Midwestern cornstarch might be even worse than gasoline in its net greenhouse gas emissions. But thanks to that oil yield figure of 1 MT/ha, most observers would agree that oilseed-derived biodiesel fuels have fairly robust environmental credentials.

Table 1. *Estimated oil yields from selected crops*

Crop	Previous estimates, MT/ha[a]	New estimate[b], MT/ha
Canola (rapeseed)	1.2	0.49
Sunflower	1.0	0.42
Groundnut (peanut)	0.84	0.4
Soybean	0.56	0.36
Oil palm (includes kernel oil)	4.1	4.1
Maize (corn) ethanol	3.1	1.6

[a]MT/ha, metric tons per hectare.
[b]Johnston *et al*., 2009.

Mature oil palms.

However, all those assumptions may need to be revised if the conclusions of a recent, carefully crafted survey of global energy crop yields are correct. The results were published in the journal *Environmental Research Letters* in January 2009 by a group led by Matt Johnston from the University of Wisconsin-Madison (USA). Their surprising conclusion is that for nearly all crops, we have got our oil yield figures seriously wrong. In most cases, they reckon that yields were overestimated by about 100%, while some crops like groundnut grown for biodiesel and wheat grown for bioethanol may have been overestimated by more than 150%. This means that our ballpark figure for oil yield from annual oilseed crops should be less than 0.5 MT/ha, instead of 1 MT/ha.

And there was another sting in the tail of the Wisconsin analysis. It seems that whereas annual oilseed yields may have been vastly overestimated, those of oil palm are more or less correct at about 4.1 MT/ha (made up of 3.68 MT/ha palm oil plus 0.44 MT/ha kernel oil). This means that the oil yield of oil palm per hectare may be as much as ninefold higher than that of temperate oilseed crops. Palm oil production costs are also lower because the crop is perennial, so it does not require annual sowing, and it is normally grown in lower wage regions of the world.

Moreover, whereas temperate oilseed crops may already be close to their maximum biological potential oil yield, oil palm breeders are developing varieties that yield in the region of 9–16 MT/ha, which is a massive 20- to 35-fold higher than canola or

sunflower. Perhaps now may be a good time to consider investing in the burgeoning oil palm industry in South America, where new high-yielding plantations are rapidly coming on-stream in countries such as Colombia and Ecuador. This is already happening in Africa, where China has reportedly secured rights to grow palm oil on 2.8 million ha in Congo and is now negotiating for a further 2 million ha in Zambia. The amount of oil that could be produced on 4.8 million palm-planted ha would require about 55 million ha of soybean, almost double the area of the entire US soybean crop (estimated at 31 million ha in 2009).

If these surprising results from the Wisconsin study are confirmed, they could fundamentally challenge our assumptions about the environmental case for biofuels as a major element in future strategies for sustainable energy provision. They could also affect sentiment about the wisdom of using food or feed crops as bioenergy feedstocks. This is especially topical at a time when the United Nations is dramatically increasing its estimates of the numbers of people suffering acute food shortages, and as the economic downturn and food price hikes disproportionately affect the poor in developing countries. Commenting on the significance of their study, Matt Johnston said:

"Our evaluation of crop yields shows the importance of place- and crop-specific data to inform decision-making on agricultural biofuels. Additional work would be required to evaluate the environmental benefits of specific biofuels produced at specific places, but it is clear that the life-cycle costs are highly dependent on where and how crops are produced."

*inform*ation

For further reading:

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