PRAKTIJKONDERZOEK
PLANT & OMGEVING
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Sustainability of bio-energy crop production

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Conclusion

Crop rotations with energy sugar beet, energy rape seed and energy maize have only little negative or even positive effect on soil organic matter supply, NH_3-emission, nitrate leaching and pesticide use compared to standard crop rotations.



Introduction

Sustainability of biomass production for energy has been debated. In this paper environmental parameters as mentioned above are calculated in a case study with bio-energy crop rotations and standard crop rotations.

Material and methods

A typical rotation for the South East of the Netherlands was drawn up. Then alternative rotations with energy crops were set up (Table 1). Data for crop management were based on common practice. Environmental parameters were calculated. Additionally, an extra scenario was taken into account by replacing the pig slurry that was used in rotations 0-4 with cattle slurry. Pig slurry is most common in the region, whereas organic matter supply is higher through application of cattle slurry.

Table 1. A typical rotation for the South East of the Netherlands and alternative rotations with energy crops. Numbers represent the share of a crop in the rotation in (%) (green manures excluded).

No		1	2	3	4
	Control	Energy beet	Rape seed A	Rape seed B	Energy maize
Potato					
Ware potato	25	25	25	25	25
Beet					
Sugar beet	15		15		15
Energy sugar beet		25			
Cereal					
Spring barley	10	0	0	0	
Corne maize	15	15	15	15	
Winter rape seed			10	25	
Energy maize					35
Vegetables					
Canned pea	10	10	10	10	
Carrot	15	15	15	15	15
Scorzonera	10	10	10	10	10
Green manure					
Different types	30	20	20	25	45

Results

Soil organic matter. The amount of soil organic material added was lower in the rotation with energy beet and energy maize than in the control rotation. The whole crop is harvested in the energy crops whereas only the beets or grains are harvested in the original crops (Figure 1). However, if cattle slurry is applied instead of pig slurry, organic matter supply is much higher.

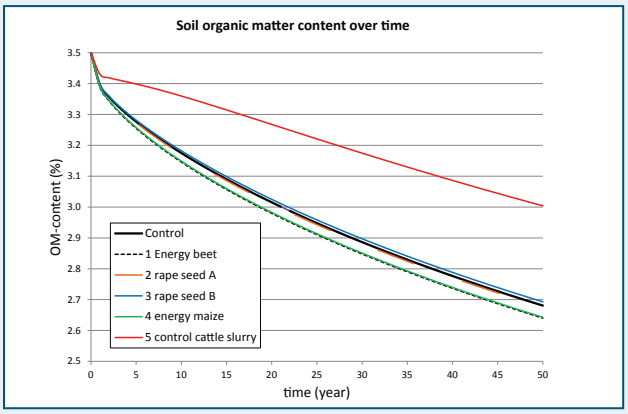

Figure 1. Soil organic matter course based on the model by Yang (2000) of the reference rotation (control) in the South East of the Netherlands and alternative rotations with energy crops.

NH_3 emission. NH_3 is emitted during application of nitrogen, especially organic manure. Energy crops demand higher nitrogen levels than substituted spring barley. More NH_3 is therefore emitted in rotations with energy crops than in the control rotation.

Nitrate leaching. Crops differ in N-input and N-harvested and therefore in N-surplus. For energy maize and energy beet the whole crop is harvested resulting in an increased N-offtake and a lower NO_3 concentration in ground water.

Table 2. NH_3 emission and NO_3 concentration in ground water of all rotations.

No	Rotation	NH_3 emission (kg N/ha)	NO_3 concentration in ground water (mg NO_3/l)
0	Control	4.4	92.3
1	Energy beet	4.5	76.8
2	Rape seed A	4.5	94.1
3	Rape seed B	4.7	98.0
4	Energy maize	4.9	82.0
5	Control but cattle instead of pig slurry	5.1	121.0

Pesticide use. (Energy) maize requires low pesticide control. Substitution of energy maize for other crops was beneficial for lowering pesticide use. Other alternative rotations were similar to the control rotation.

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ENERGIE BOERDERIJ