



In search of the optimal N fertigation dose for 'Conference' pear tree



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Fertigation is the dispersion of fertilizers through an irrigation system and allows a precise distribution of the nutrients in the root zone and is often used in 'Conference' pear tree in Belgium and the Netherlands to maximize fruit yield. To optimize the efficiency of the N fertigation, the fertigation can be applied at the end of the vegetative growing period at the beginning of fruit maturation. In this way the vegetative growth of the pear tree is minimized while fruit yield is maximized. In search for the optimal N fertigation dose this study discusses the effect of three different nitrogen doses (0, 25 kg N, 50 kg N), applied six weeks before harvest, in a humid and a dry irrigation treatment. The experiment was conducted in three different fruit orchards with varying soil profiles and planting systems in two successive years (2008-2009).

Table 1 Characteristics of the three selected orchards

Orchard	Bierbeek	Meensel-Kiezezem	Sint-Truiden
Rootstock	Quince C	Quince Adams	Quince Adams
Planting year	2000	1996	1996
Planting Distance	3.3 m x 1 m	3.5 m x 1.5 m	3.5 m x 1.25 m
Training system	Intensive V system	Free spindle	Free spindle
Average tree height	2.5 m	2 m	3.5 m
Soil texture upper soil layer (0-30 cm)	Sandy loam	Sandy loam	Loam
Carbon content upper soil layer (0-30 cm)	1.2%	1%	1%
pH upper soil layer (0-30 cm)	6.8	6.1	6.4
Mineral NO ₃ -N content soil profile (0-90 cm) (march 2008)	66.6 kg	30.9 kg	24.1 kg
Other characteristics	Situated on a slope	Shallow ground water table (1.5 m- 2 m)	

- Three different orchards (Table 1) were selected for this study.
- In a Full Irrigation regime (FI) Ψ_{soil} was maintained above -60 kPa due to irrigation, according to irrigation guidelines suggested by Janssens et al. (2011). A Deficit Irrigation (DI) regime was set up where rain repelling screens were installed in the months June and July to insure root zone depletion.
- The orchards were equipped with a "Dosatron" pumping unit to disperse fertilizers through the drippers along with the irrigation water.
- One month before bloom in 2008 and 2009 all orchards received a basic fertilization containing 30 kg N/ha using mineral fertilizers.
- In all orchards each irrigation regime (FI and DI) was subjected to three fertigation doses; 0 kg N/ha, 25 kg N/ha and 50 kg N/ha.
- Each irrigation-fertigation combination was replicated four times in a randomized bloc design.

Fertigation effects in the 'Conference' pear orchards

Table 2 Fruit yield in function of the applied fertigation regime 6 weeks before harvest. The letters a,b,c, indicate a significant difference at $p < 0.05$

Orchard	Irrigation regime	Fertigation dose (July-August)	Fruit yield 2008 (kg/tree)	Fruit yield 2009 (kg/tree)
Bierbeek	FI	0 kg N	23.94 ab	21.41 bc
	FI	25 kg N	28.89 c	22.37 c
	FI	50 kg N	25.93 abc	20.7 bc
	DI	0 kg N	22.25 a	16.59 a
	DI	25 kg N	26.95 bc	22.34 c
	DI	50 kg N	23.33 ab	19.34 ab
Meensel-Kiezezem	FI	0 kg N	27.07 a	22.58 a
	FI	25 kg N	22.46 a	24.58 a
	FI	50 kg N	21.54 a	20.75 a
	DI	0 kg N	24.68 a	21.95 a
	DI	25 kg N	24.99 a	22.97 a
	DI	50 kg N	23.29 a	23.4 a
Sint-Truiden	FI	0 kg N	14.14 a	10.03 a
	FI	25 kg N	18.14 ab	9.01 a
	FI	50 kg N	20.41 b	10.34 a
	DI	0 kg N	13.02 a	10.84 a
	DI	25 kg N	15.29 ab	12.02 a
	DI	50 kg N	18.49 b	14.63 a

Figure 1 Evolution of Ψ_{soil} measured by three Watermark sensors at a depth of 30 cm in a reference plot per irrigation regime in two orchards in 2008. Vertical bars indicated standard deviation between three sensors.

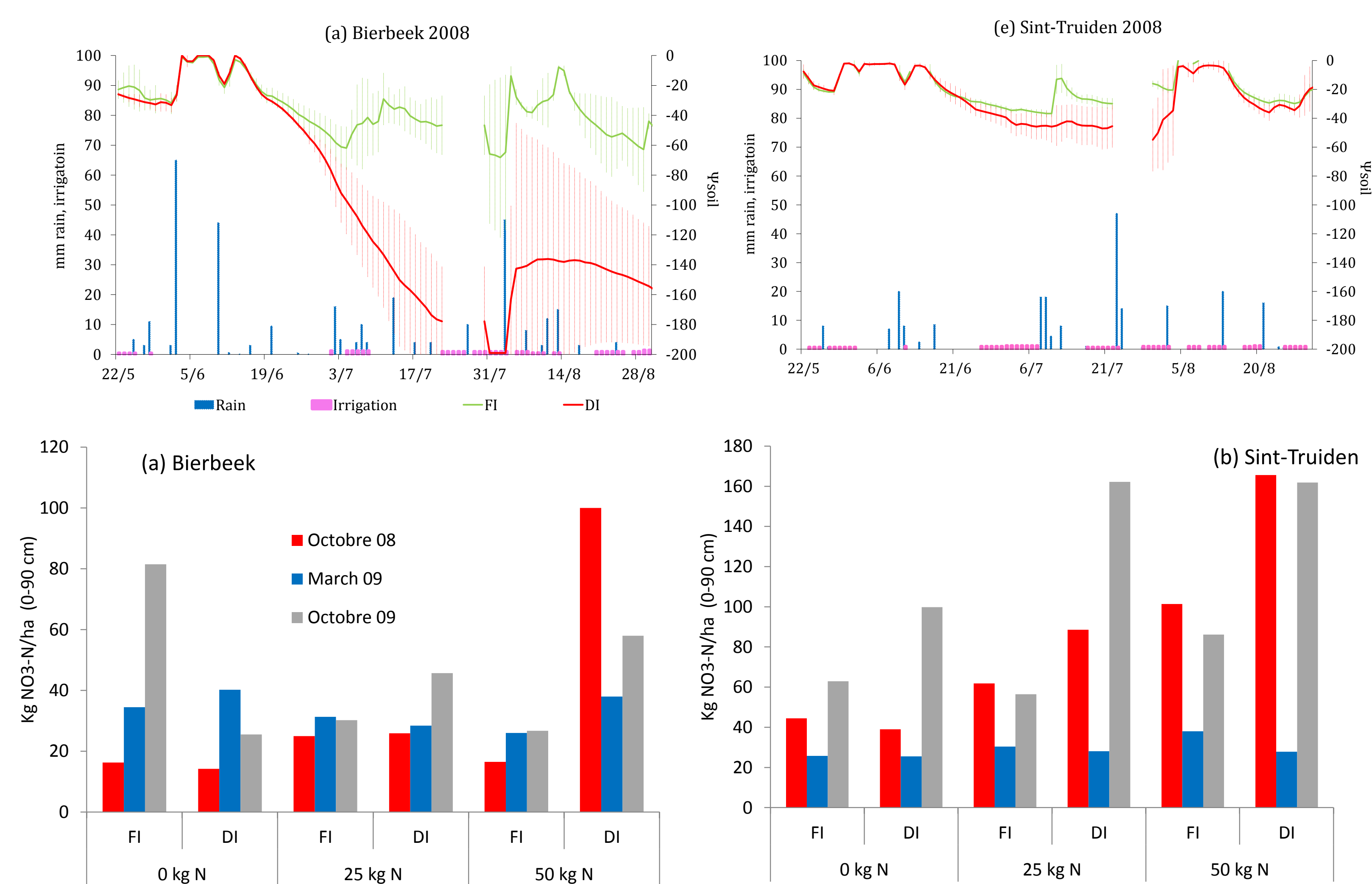


Figure 2 NO₃-N concentration in the soil in function of the fertigation regime measured at three moments in the orchards during 2008-2009.

- The irrigation had an effect on Ψ_{soil} (Fig. 1a) in Bierbeek, Ψ_{soil} declined -150 kPa in the DI treatment (Fig. 1a). In Meensel-Kiezezem and in Sint-Truiden (Fig 1b) the decrease in Ψ_{soil} in the DI treatment was less pronounced compared to Bierbeek. Irrigation had an effect on the total fruit in yield in Bierbeek (Table 2).
- Fruit yield varied with the applied fertigation regime in Bierbeek and in Sint-Truiden (Table 2). In Bierbeek fruit yield was highest in the 25 kg N fertigation treatment. In Meensel-Kiezezem no pronounced differences in fruit yield were observed when applying the three fertiation doses although yield tended to be higher in the 25 kg N treatment. In Sint-Truiden fruit yield was highest in the 50 kg N fertigation treatment in 2008 and 2009 in both irrigation regimes.
- NO₃-N -concentration in the soil in autumn was in accordance with the applied fertigation regimes in 2008 and 2009 (Figure 2). NO₃-N content in the soil in autumn tended to be higher in the DI treatment compared to the FI treatment.

Conclusion

The present experiment illustrates how fertigation can be used to apply a fractionated fertilization in 'Conference' pear tree. The optimal fertigation dose ranged between 25 kg/ha and 50 kg/ha depending from the orchard. Water stress negatively affected the N uptake of the tree and increased the NO₃-N content in the soil profile in the autumn.

Reference used: Janssens, P., Deckers, T., Elsen, F., Elsen, A., Schoofs, H., Verjans., W., Vandendriessche, H., 2011. Sensitivity of root pruned 'Conference' pear to water deficit in a temperate climate. *Agric Water Manage* 99, 58-66.

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