NUTRIENT LOSS WITH SURFACE IRRIGATION

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Description
The control and reduction of P movement and loss from soils due to runoff or excessive leaching promoted by surface irrigation

Rationale, mechanism of action
Furrow or sprinkler irrigation in non-flat plots can promote soil particles and dissolved P movement and loss from soils [1,2]. Irrigation after high fertilizer rate application may promote incidental losses of nutrients [3]. Non-accurate irrigation rates may promote excessive leaching and losses of dissolved forms of nutrients like N and P. In the case of P this mechanism should be relevant in soils with a high degree of sorbent surface saturation or in cracking soils with tile drains [4]. Thus, with the irrigation of soils using these systems it should be taken into account that:

- Furrow irrigation should only be used in plots with the slope necessary to allow water movement. Care should be taken to ensure a high efficiency in water application (e.g. no cracks open).
- Sprinkler irrigation should be used at intensities lower than the infiltration rate of soil to avoid runoff and to enhance a high efficiency in the use of water. Soil cover during irrigation periods (crop, crop residues) reduces runoff.
- Accurate calculation of irrigation rates and irrigation intervals should be done.
- High frequency - low rates irrigation systems (drip irrigation) are desirable if conditions are not accurate for furrow or sprinkler irrigation (as stated above).
- In tile drained cracking soils high frequency irrigation systems (low rates applied frequently) are preferable during summer time (crack opening which reduce irrigation efficiency – water losses through preferential flow)
- Accurate timing of fertilization in relation to irrigation is necessary to avoid incidental fertilizer losses.

Applicability
Irrigation is an agricultural practice applied in humid areas during drought periods. In arid and semi-arid climatic areas it is necessary to avoid water deficiency in dry seasons: e.g. in Mediterranean climate areas in summer time with less rain than evapotranspiration.
Accurate calculation of irrigation rates and frequency involves the knowledge of the water retention capacity of soils, water requirement of crops, and daily evapotranspiration. For countries of Southern Europe (in general for arid and semiarid regions), the Pennman-Montheith method for calculation of ET_o is recommendable [5]. An accurate calculation of the leaching fraction (fraction of irrigation water which is lost by drainage) to avoid salt accumulation in soils should be performed. Special care should be taken when the crop cover of soil is still low, in particular to avoid runoff losses related to irrigation.

Effectiveness, including certainty
Overall, high efficiency (a small water loss fraction through runoff or drainage) of water not only implies to save a relevant limiting factor for agriculture in arid and semiarid countries, but is also important for reducing nutrient losses. In south Spain for example, water table nitrate pollution is linked to high N rates in irrigated areas. There is significant evidence of reduced N and P losses in tile drained soils when the efficiency in water use is increased, and the fraction of water lost by drainage is decreased. In order to decrease P losses, timing of fertilization in relation to

irrigation is not significant in soils with a high P sorption capacity [4], whereas in the case of N it is very important not to apply high rates of fertilizer just before irrigation [3]. Splitting up of N fertilizer application is necessary on irrigated soils, and could be of particular interest for the use of fertigation in drip irrigated soils to reduce N losses.

Time frame
In general terms, the effect of decreasing N and P losses and a lower frequency of incidental losses can be expected on short term.

Environmental side-effects / pollution swapping
Additional positive effects on loss of pesticides or sediments are expected. Also, water saving in dry regions is an additional and relevant potential benefit of this measure.

Relevance, potential for targeting, administrative handling, control
The option can be relevant for all irrigated fields, in particular where the soil P status is above optimal for crop growth and where high amounts of N and P fertilizers are applied.

Costs: investment, labor
An accurate calculation of irrigation rate and frequency does not imply costs or investments. Administration should facilitate calculations [e.g. 6]. When it is recommended to change the irrigation system the investment cost could range between 1000 and 3000 € per ha. For this purpose it may be necessary to facilitate subsidies for covering costs of investment which should consider not only the reduction of non-point pollution (N, P, pesticides), but also soil conservation and water saving, which are important items in arid and semiarid regions.

References
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