The Challenge

Turkey is the fifth largest exporter of potatoes, producing around 4.4 million tonnes of potatoes annually on about 154,000 hectares (ha). More than one third of the total production is grown in the Nigde-Nevsehir region, with an average yield of 40 t/ha. This is an arid and semi-arid region with light-textured, loamy sands and production is totally dependent on sprinkler irrigation that relies on residual groundwater provided by spring rainfalls. About 1400-1700 mm of water is required under sprinkler irrigation to achieve marketable potatoes, of which only 35% is taken up by crop roots in the top 90 cm of the soil. The remaining 65% is lost through runoff and downward water movement beyond the plant roots. This excessive use of water also reduces the efficiency of water-soluble nitrogen fertilisers, such as urea or ammonium sulphate, in providing nitrogen for potato production. The main challenges are to increase water and nitrogen fertiliser use efficiency by applying irrigation water mixed with fertilisers, also known as fertigation, to the right place, at the right time and in the appropriate amount.

The Project

Through an IAEA technical cooperation project, the Turkish Atomic Energy Agency, in cooperation with the Nigde Potato Research Institute and the Soil and Fertilizer Research Institute, implemented innovative drip fertigation technology to improve water and nitrogen fertiliser use efficiency in potato production in the Nigde-Nevsehir Region. This technology reduced the amount of irrigation water needed by 50% and nitrogen fertiliser use by 40%, from 1000 kg nitrogen/ha to 600 kg nitrogen/ha.

The Technology

Drip fertigation technology increases water and nitrogen use efficiency by applying water and nitrogen directly to the immediate vicinity of the plant roots through a network of pipes and water emitters. This leads to a reduction in soil water evaporation and excess water loss beyond the rooting zone, so that much less irrigation water and nitrogen fertiliser is needed.

The soil moisture neutron probe (SMNP) is an instrument that measures soil water content at any time for crop production. During the measuring process, the probe emits neutrons that collide with hydrogen atoms of soil water. This collision slows down the speed of the neutrons. The change in neutron speed is detected by the probe and provides a reading that corresponds to soil moisture content. Thus soil moisture measurement using SMNP is important to the effective scheduling of drip fertigation.

Nitrogen is a major nutrient for plant growth. Labelling nitrogen (N) fertilisers with \(^{15}\text{N}\) stable isotope tracers help assess how nitrogen fertilisers are taken up by crops and moved down the soil profile beyond the reach of plant roots. This information is necessary to determine the fate of applied nitrogen fertilisers in soils, plants and water, and hence the nitrogen fertiliser use efficiency in crop production systems.
The Impact

Considering the magnitude and importance of potato production in the arid and semi-arid areas of Turkey, the 50% reduction in crop water requirements through drip fertigation is having a major impact on agricultural production and water management strategies in these areas. Likewise, the 40% reduction in nitrogen fertiliser needs is a major step towards reducing farmers’ expenditure and potentially improving groundwater quality in these agricultural landscapes.

For the farmer, it has been calculated that a transition from sprinkler irrigation to drip fertigation requires an initial one-off investment cost of up to US $200/ha, depending on the sophistication of the drip fertigation system. This investment can be balanced against projected savings in time, energy, fertiliser and labour costs amounting to an estimated US $2,000/ha/year. As a consequence, interest in drip fertigation has been remarkable among potato farmers in the region, so that in only three years the area under drip fertigation has increased from humble beginnings of 500 hectares in 2005 to 4000 ha in 2007 and to nearly 7000 ha in 2010. In efforts to further accelerate this transition, the government, following a request from the Ministry of Agriculture, has developed a regional policy through which it now subsidises 50% of the investment costs for drip irrigation systems. It is expected that the potato-growing area under drip fertigation will climb to 10,000 hectares by the time of planting in June 2011, due to a local financial subsidies promised by the Governors of the Niğde and Nevşehir provinces of the Capadocia Region for the 2011 financial year, in addition to the already implemented central government subsidy policy.

For further information, please visit:
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