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Developing Usable Precision Agriculture Systems for Potato in Australia

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Precise management of crop inputs, particularly crop water requirements, will have an enormous future bearing on crop profitability and agricultural sustainability. Globally, fields and the crops within the field are treated as an average. Fertilizer is applied as an average for the field, plant density is an average for the field and irrigation is usually applied as a constant volume over the area. But, the actual requirement of microsites within a field varies enormously. Soils in Tasmania vary from rich volcanic ferrosol to coastal sands and duplex loams and often, more than one soil type can be found within an individual field.

This project is using Electromagnetic induction and global positioning systems technology (EM38) to map spatial variability of soil conductivity. Factors such as soil moisture content, salt levels and soil texture affect the concentration of conductive materials and all influence the soil's apparent electrical conductivity. In 2009–2010, precision agriculture trials have revealed yield variations exceeding 350%. In real terms this relates to losses of Australian dollars (AUD) $ 5,000 per ha to profits of AUD $ 11,000 per ha, all within the same field. The EM 38 map can also be adapted to the centre pivot computer so irrigation volumes alter to match changing soil textures and ultimately the plant demand within those changed textural zones. The manipulation of applied water volumes has resulted in greater recovered yield, more consistent tuber sizing and quality, together with savings in the water resource.

An Ecophysiological Model Approach to Analyse Canopy Dynamics in Potato (*Solanum tuberosum* L.)

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An ecophysiological model was designed to quantify variation in potato (*Solanum tuberosum* L.) canopy dynamics. Model algorithms describe the build-up phase, maximum cover phase, and decline phase based on five parameters: t_{m1} (transition from accelerating to diminishing growth during the build-up phase, t_1 (end of the build-up phase when canopy cover attains its maximum level v_{max}), t_2 (end of the phase of maximum cover), and t_e (end of the crop cycle). Parameter values were estimated for 5 cultivars and 100 individuals of an F1 population using data collected in 6 field experiments. The model successfully described differences in canopy dynamics among individual genotypes across environments. Model parameters were used to derive several secondary variables: P_1, P_2 and P_3 (length of the three phases) and A_{sum} (area under the canopy cover curve reflecting the crop's capacity to intercept incoming radiation). P_1 was relatively conservative, but P_2 and P_3 varied greatly. There were negative correlations among P_1, P_2, and P_3, suggesting that genotypes with slow canopy build-up had a relatively short P_2, but a relatively long P_3. Furthermore, P_2 was short when v_{max} was below 100%, whereas it could be (much) longer when v_{max} reached 100%. Later genotypes had a higher A_{sum} because they had longer P_2 and P_3. Total biomass production depends on the absorbed photosynthetically active radiation, which is proportional to A_{sum}. Potato models predicting yield could use our approach to improve estimates of canopy light interception under diverse environmental conditions. Our approach also allows identifying potato canopy characteristics relevant for breeding.

Influence of Some Agronomical and Environmental Factors on Tuber Yield and Quality of Potato Grown in Organic Production System

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In experiments carried out at two sites in Poland (central and east-south) in the years 2008–2009, effects of different environmental and agronomical conditions on yield and potato tuber quality grown in an organic production system were tested. Despite better soil conditions and richer crop rotation at site 2, the total and marketable tuber yields were higher at site 1. The external and internal tuber quality depended on all tested factors; however, genotype had the biggest effect. Chemical composition of tubers also depended mostly on cultivar characteristics. The environmental conditions had a large influence on taste and tuber flesh darkening.