

KNOWN ISSUES RELATING TO THE USE OF EU-ROTATE_N (27/7/07)

Since the model has been developed several issues have been raised by the users that need further work. These issues relate to the use of the model in specific cases where it needs to be trained to more closely match those circumstances. An example of this is whilst the routines used to simulate the release of N from soil organic matter over a range of climatic conditions have been produced there are times when the expected amounts of mineralisation are too high or too low. The value of the organic matter level in the top 30 cm can be varied to suit expectations of mineralisation at a particular site.

Whilst the model simulates the relationship between marketable yield and total dry matter yield in a reasonably precise manner for several crops it cannot possibly simulate that for all crops grown under all conditions and the values in the crop table can be adjusted to better simulate these relationships for individual crops.

A summary of the results of the validations for the main sub-routines is shown below with specific warnings and actions required to overcome the main difficulties identified. With more use more problems are inevitably going to come to light so please let the developers know especially if you can provide a solution.

Water Balance

The model has a novel two-dimensional soil water balance module that allows calculation of water use and water movement both vertically and horizontally. Thus it is suited for situations such as wide-row crops and trickle- and furrow-irrigation, as well as conventional conditions.

Potential evaporation, calculated from latitude, altitude and readily-available weather data, is probably adequate for most situations, but may be substituted with other measured if desired. The routine for actual evapotranspiration assumes crop coefficients based on lengths, in numbers of days, of individual growth phases. These sometimes require modification by the user to suit local conditions. A simpler solution is desirable, based, for example, on day-degrees instead of time. The module also requires the user to make two somewhat arbitrary choices, both of which have been shown to have a marked effect on water movement (surface runoff ON/OFF, and drainage rate from 0.0 to 1.0). Evaluations in northern Europe have suggested that default values result in too little water movement. More testing and better guidelines are therefore required for a range of soils and environments. Underestimation of evaporation from bare soil has also been indicated in Danish simulations, but the reason for this is not yet established.

It is suggested that in most growing situations runoff should be switched off and the drainage coefficient should be set to 1

Root growth

The root growth module is a highly innovative feature of the model, representing a 'state of the art' portrayal of two-dimensional root growth that may be adjusted for all crops. Coefficients for many of the major crops are well-documented, whilst for some less common ones they are based on assumptions that may need more verification. The model includes a possibility for the user to stipulate a maximum rooting depth below which roots cannot penetrate. Though in some cases there may be clear reasons for so-doing (shallow bedrock, high water-table etc.), the user very often has no way of justifying a limitation to rooting depth. Often no such limitation exists. However, a means of taking account of such factors as suboptimal soil structure (low macroporosity, high penetration resistance etc.) would be a clear improvement to the model, although this was outside the scope of this project. A

thorough sensitivity test of simulated root growth and associated N uptake has been performed.

Snow Frost

The snow/frost depth module, though relatively simple, appears to give an adequate description of winter conditions where applicable (i.e. northern and/or continental climates). The interaction of frozen soil with surface runoff in freeze/thaw periods gives a reasonable representation of reality. Though in fact part of this 'winter runoff' may in fact take place by bypass flow in soil macropores, the effect on leaching during winter is thought to be similar.

Mineralization

The module for soil nitrogen dynamics is based largely on the established DAISY model, and encompasses all important N processes and flows. Evaluations show that these are simulated in a logical manner, but there has been uncertainty about parameter values in some cases. Mineralization in an organically-amended soil in southern Europe was underestimated, whilst that of soils with a high content of recalcitrant organic matter, as in northern Europe, may be over-estimated. A simple means is required of adjusting the model to such variations. Excessively rapid mineralization of plant residues has also been indicated in some cases, suggesting that more work is needed to parameterize and/or document this aspect.

Before using the model the mineralization of N from soil organic matter in the climatic zone of the case study should be tested. It is possible that in some situations the soil organic matter status of the soil may need to be altered to deliver the expected annual input from the mineralization of N from soil organic matter. This was thought only to be a problem in very extreme, hot or cold environments.

Crop Growth

The crop growth module is based on user-supplied targets expressed as total DM. This concept worked well in evaluations, as data for total DM was in all cases available. In actual practice, a basic weakness is that most users are only able to state their target in terms of product fresh-weight. This means that target total DM must be estimated indirectly, by means of a separate routine that is at present not included in the model (e.g. the R-target spreadsheet developed at HDRA for FW/DM conversion). Whilst the target DM values limits potential growth, actual growth is limited by N availability in relation to crop-specific critical N% curves. The latter are well-documented for major crops, but for many vegetable crops they are based on rather few observations. Evaluations have revealed examples of cases where the assumed critical N curves are too low (e.g. carrots) or too high (e.g. onion, cauliflower). This has a significant effect on simulated fertilizer responses, leaching and gross margins. The option to include the effect of water stress on growth was a late addition to the model, but appears to function as intended. More testing is required for a range of crops.

The total yield expectations should be carefully chosen – as any errors in the yield expectation will have a marked effect on crop N uptake. If crops are unirrigated then the total yield expected should be included or the adjustment for water stress needs to be switched on.

Marketable yield

The module that calculates marketable yield and amounts of crop residues from total DM, includes two alternative means of calculation: 'direct conversion' (1) or 'single plant' (2). The approach is flexible but highly nevertheless empirical. Whilst default values are given for all crops, experience with these in evaluations so far has been rather inconsistent, suggesting that considerably more experimental data is required. The 'single plant' method can only be used if the marketable product is a single part of a plant, e.g. cabbage head but not Brussels sprouts. For all those crops 'single plant' is the default method used by the model. Among them are: cabbages, cauliflower, carrot, parsnip, leek, onion, head-lettuces, melons...- see (2)

in column “R_ST” of the croptable. All other crops are calculated with ‘direct conversion’ (1 in column “R_ST”).

The outputs from the scenario runs need to be checked in order to ensure that the calculations of marketable yield are in a sensible range.

Fertility Building crops

The routines for fertility-building crops are broadly satisfactory. However, more work is required to refine the crop growth and residue parameters used for various crops and to test the new parameters under a wider range of conditions. Specific problems with regard to mineralization of long-term crops were found, and a new approach may be needed to model this. It is particularly important for these problems to be addressed if the model is to be used under organic conditions where long-term fertility building crops are the main source of N.

Economics

The economics has not been evaluated specifically, though users have had experience of its use in connection with WP5. The concept of gross-margins is well established in farm management and is thus a useful addition to the model. An essential requirement for the future is that the economics database must be kept up to date with respect to costs and prices.