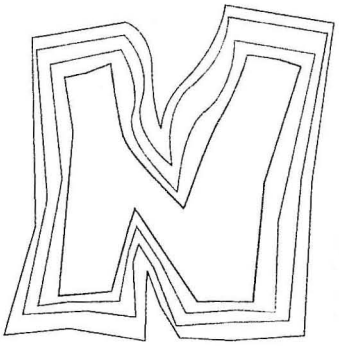

18th NITROGEN WORKSHOP

THE NITROGEN CHALLENGE: BUILDING A BLUEPRINT FOR NITROGEN USE EFFICIENCY AND FOOD SECURITY

18th Nitrogen Workshop

PROCEEDINGS

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PRELIMINARY CRITICAL NITROGEN NUTRITIONAL INDICES FOR LEMON BALM (MELISSA OFFICINALIS) GROWN IN A MEDITERRANEAN ENVIRONMENT IN NORTH-EASTERN PORTUGAL

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The management of crop fertilization presupposes previous diagnoses of soil fertility and plant nutritional status. In Europe, regular soil testing and plant analysis is mandatory for farmers receiving EU subsidies. Soil testing provides information on the potential availability of nutrients in the soil, a key component in the fertilization recommendation systems. By analyzing plant tissues we can access the nutritional status of a crop, which allows understanding if supplemental fertilization is needed. Without these means of diagnostic, fertilization is an entirely empirical practice. The sector of Medicinal and Aromatic Plants (MAP) seems to be out of that logical. For most MAP it were not yet established sufficiency ranges or critical levels that allows the interpretation of plant analysis results (see Mills and Jones, 1996; INIAP-LQARS, 2006). Taken into account that most of MAP production in Europe is organic, and that this may requires the use of expensive commercial organic manures, the situation seems to be unsustainable. There is a real need for sufficiency ranges or critical levels allowing the use of plant analysis as a diagnostic criterion on its nutritional status for a judicious decision on the rate of nutrients to apply. This work is part of a wider project that is still beginning, which main goal is to establish sufficiency ranges or critical levels for some MAP that are having great economic importance in Portugal. In this paper, preliminary results for lemon balm (*Melissa officinalis* L.) are presented.

Materials and Methods

Data were collected in a field fertilization trial of lemon balm where different rates of the nutrients were applied in the form of liquid fertilizers allowed for organic farming. The experiments were located in NE Portugal. The region benefits from a Mediterranean climate. The soil is a Leptosol derived from schist. The texture is sandy-loam, pH 6.5 and an organic matter content of 14 g kg^{-1}. Plants are spaced at 40 x 30 cm. They were planted in holes made in a black plastic mulch used to protect the crop against weeds. The results here presented were obtained from a cut made at the beginning of flowering on September 2, 2013. The dry matter yield and nitrogen nutritional status indices were recorded from experimental plots of 18 useful plants. In the field, SPAD readings were taken by using the portable SPAD 502 Plus chlorophyll meter, which provides an indication of the relative amount of chlorophyll present in plant leaves. The values are calculated based on the amount of light transmitted by the leaf in two wavelength regions in which the absorbance of chlorophyll is different (650 and 940 nm). The Normalized Difference Vegetation Index (NDVI) was also determined by using the portable FieldScout CM 1000 NDVI meter. The Meter senses the light at wavelengths of 660 nm (chlorophyll absorption) and 840 nm (entirely reflected by chlorophyll) to estimate plant health (the relative greenness of the leaf). A NDVI value (-1 to 1) is calculated from the measured ambient and reflected light data [(%Near Infrared – %Red) / (%Near Infrared + %Red)]. From each individual plot five

plants were cut and carried out to the laboratory. A subsample was oven dried at 70 °C allowing estimate the dry matter percentage of the biomass. The other subsample was used to prepare tissue samples for elemental determination. Samples of young and fully expanded leaves (between the 4th and the 10th leaves from the tip) were prepared as well as samples of shoot tips (including stems and leaves) with approximately 8 cm in length. Tissue samples were thereafter dried at 70 °C, ground and analyzed for nitrogen concentration by a Kjeldahl method. Thereafter, critical levels were estimated for the four indices of plant nutritional status by using the original Cate-Nelson graphical method which is based upon dividing the *Y-X* scatter diagram into four quadrants and maximizing the number of points in the positive quadrants.

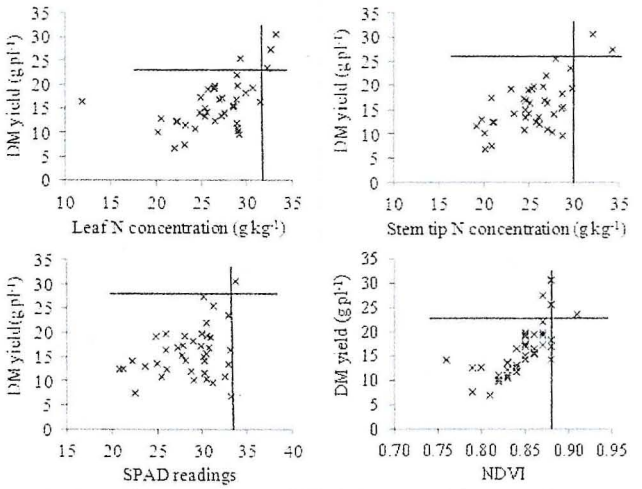

Figure 1. Scatter diagrams of dry mater (DM) yield of lemon balm *versus* plant nitrogen nutritional status indices (leaf and stem tip nitrogen concentration, SPAD readings and Normalized Difference Vegetation Index, NDVI). The vertical lines define the critical value for each nitrogen nutritional index.

Results and Discussion

It was found a linear relationship between dry matter (DM) yield and leaf nitrogen concentration (Figure 1), suggesting that nitrogen was a limiting factor of crop growth in many experimental plots. Significant linear relationships were also found between DM yield and stem tip nitrogen concentration and NDVI. SPAD readings did not correlate so well with DM yield. The results point to critical levels for leaf nitrogen concentration close to 3.2 g kg^{-1} (Figure 1). If the tip of stems were used as sampling tissue, critical nitrogen concentration was found close to 3.0 g kg^{-1}. Critical SPAD reading was found close to 34 units and the critical NDVI was found close to the value 0.88.

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Cate Jr RB, Nelson LA 1965. In Soil Test Correlation, Calibration and Interpretation; Dahnke C (Ed.). North Dakota State Univ. Exp., Fargo, ND, Bull. 517, 2-8.

INIAP-LQARS 2006. Manual de fertilização das culturas. INIAP-LQARS.

Mills HA, Jones Jr JB 1996. Plant Analysis Handbook II. MicroMacro Pub. Inc., Athens, GA.