THE USE OF FOLIAR FERTILIZER APPLICATION IN SUGAR BEET GROWING

DOTT. VINCENZO TUGNOLI – DOTT. GIOVANNI BETTINI

Sugarbeet Grower Association (Associazione Nazionale Bieticoltori) – Technical Service
Via Collamarini 14 - Italy – 40138 Bologna

ABSTRACT

The experience of ANB Technical Services has demonstrated that the use of foliar fertilizers can resolve late (at approximately the 16-leaf stage) deficiencies in macro and microelements. Foliar application of nitrogen is particularly useful as it provides the most immediate assimilation and avoids the need for late application of granular mineral fertilizers that penalize polarization and qualitative crop yield. Moreover it has been shown that the increasingly evident deficiencies of boron and manganese in Italian fields are resolved with the application of specific foliar fertilizers. The application of such fertilizers is also useful in post-emergence weed control mixtures, improving the effectiveness of the active principles vs. the weeds and helping the crop overcome the effect of chemical treatments, particularly with the least selective products. The foliar application of amino acids, seaweeds and bio-stimulants has proved effective in attenuating crop stress resulting from soil subsidence, a lack or excess of water, low temperatures and other weather conditions. The present work reports the results of field trials and programs of treatments at various stages of crop growth. Several years experimentation by ANB Technical Services indicate a 12-15% improvement in sugar production in Northern Italy and a 15-18% improvement in Central Italy. Therefore, it appears evident that the use of foliar fertilizers makes it possible to quickly overcome the nutritional and environmental deficiencies that arise during the crop growth cycle.

ABRÉGÉ

Des expériences réalisées par le Service Technique d'ANB démontrent que l'apport de fumures foliaires est en mesure de faire face à l'apparition tardive (environ 16 feuilles) de carences provoquées par des macro et des micro-éléments. L'apport d'azote par fumures foliaires est particulièrement utile en raison de l'assimilation immédiate et du fait qu'il permet d'éviter des administrations tardives d'engrais minéraux granulés capables de pénaliser le degré polarimétrique et le rendement qualitatif de la culture. L'on souligne de plus que les carences de bore et manganèse toujours plus évidentes dans les betteraviers italiens sont éliminées par des interventions foliaires spécifiques. Leur application avec les désherbages après la levée est également utile pour améliorer l'action des principes actifs désherbants sur les mauvaises herbes et pour aider la culture à résister à l'action des produits chimiques, notamment ceux qui sont caractérisés par une sélectivité mineure. L'apport par fumures

foliaires d'acides aminés, d'algues et de biostimulants est apparu efficace pour atténuer les conditions de stress de la culture à la suite des travaux de battage, de carences ou d'excès d'eau, de basses températures et d'autres phénomènes atmosphériques. Le présent document indique les expériences significatives et les programmes d'intervention concernant les différentes phases de culture. Les recherches expérimentales effectuées par le Service Technique ANB pendant plusieurs années indiquent de meilleures valorisations productives en saccharose de 12-15% dans l'Italie du Nord et de 15-18% dans le Centre. Il est donc évident que l'utilisation de fumures foliaires permet de combler rapidement les carences nutritionnelles et environnementales pouvant survenir au cours du cycle de culture.

KURFASSUNG

Von dem Technischen Dienst von ANB vorgenommene Versuche beweisen, dass durch die Zuführung von Blattdüngemitteln dem späteren Erscheinen (bei etwa 16 Blättern) eines Mangels an Makro- und Mikroelementen Widerstand geleistet werden kann. Besonders nützlich resultiert die Zuführung von Stickstoff durch die Blätter, wodurch eine unmittelbare Assimilation erzielt wird und spätere Behandlungen mit granulierten Mineraldüngemitteln vermieden werden können, die in der Lage sind, den polarimetrischen Grad so wie die qualitative Ergiebigkeit der Kulturen negativ zu beeinflussen. Darüber hinaus wird darauf aufmerksam gemacht, dass der immer offener zutage tretende Mangel an Bor und Mangan bei den italienischen Zuckerrüben durch spezifische Blatteingriffe beseitigt werden kann. Die Anwendung dieser Eingriffe ist äußerst effizient auch in Verbindung mit der Unkrautvertilgung, damit die Wirkung der unkrautvertilgenden aktiven Elemente auf dem Unkraut optimiert und der Anbau bei der Überwindung der Auswirkungen der Chemikalien unterstützt werden, besonders der mit der geringeren Selektivität. Die Zuführung von Aminosäuren, Algen und Biostimulatoren durch die Blätter resultierte über alle Maßen positiv für die Milderung der Stressbedingungen des Anbaus infolge von Bodensenkungen, Mangel oder Übermaß an Wasser, niedrigen Temperaturen und anderen atmosphärischen Einflüssen. Im vorliegenden Bericht sind bezeichnende experimentelle Erfahrungen so wie Programme von Eingriffen aufgeführt, die sich auf die verschiedenen Anbauphasen beziehen. Die langjährigen, von dem Technischen Dienst von ANB ausgeführten experimentellen Untersuchungen zeigen besonders produktive Wertsteigerungen der Saccharose von 12 – 15% in den Gebieten von Norditalien und von 15 – 18% in Mittelitalien an. Daraus geht eindeutig hervor, dass durch die Verwendung von Blattdüngemitteln die Möglichkeit gegeben ist, umgehend nutritive und umweltbedingte Mängel zu beseitigen, die im Laufe des Anbauzyklus auftreten können.

INTRODUCTION

The future of sugar beet cultivation in Italy is inherently linked to the ability to increase productivity and, consequently, the agronomic benefits this crop has on the entire crop rotation. The differences that currently exist between Italian production and that obtained in other European countries has triggered a search

for innovative cultivation practices able to counteract the inclement weather. An initial step is to implement the best techniques without committing errors. During the various phases of plant development, adequate plant nutrition plays a fundamental role in achieving the set objectives. The contribution made by fertilizers must be rational without creating any imbalance, either in excess or in deficit as both can be detrimental to production. Likewise, reduced availability of such microelements as boron and manganese in the soil can interfere with beet development. A lack of boron is manifest with small lemon-yellow spots on the leaves and subsequent extension over the entire leaf except for the central, and often the secondary, nervations which remain light green. In severe cases, necrotic spots are seen at the edge of the leaf which curls upward and plant growth progressively slows down. On the other hand, a lack of boron is most evident in the traditional browning of the "core" of the beet.

ANB EXPERIMENTAL TESTS

Aiming to prevent the onset of those negative conditions which are so detrimental to proper plant development, the Associazione Nazionale Bieticoltori (National Sugar Beet Growers Association) has sought cultivation techniques able to enhance productivity. The purpose of the present work has been to illustrate some solutions which could prevent the onset of a deficiency in nitrogen and/or microelements. A comparison has been made between various liquid foliar fertilizers and the traditional granular fertilizers applied on the soil. Using a foliar application technique rather than the traditional granular elements, late application, after some leaf yellowing had appeared, permitted a rational supply of nutrients and prevented the onset of plant stress, even following evident lack of such microelements as boron and manganese. The crop must always be placed in the best possible conditions to facilitate prompt, total beet development.

MATERIALS AND METHODS

The experimental tests were performed in different areas in Central and Northern Italy; areas with different climatic trends.

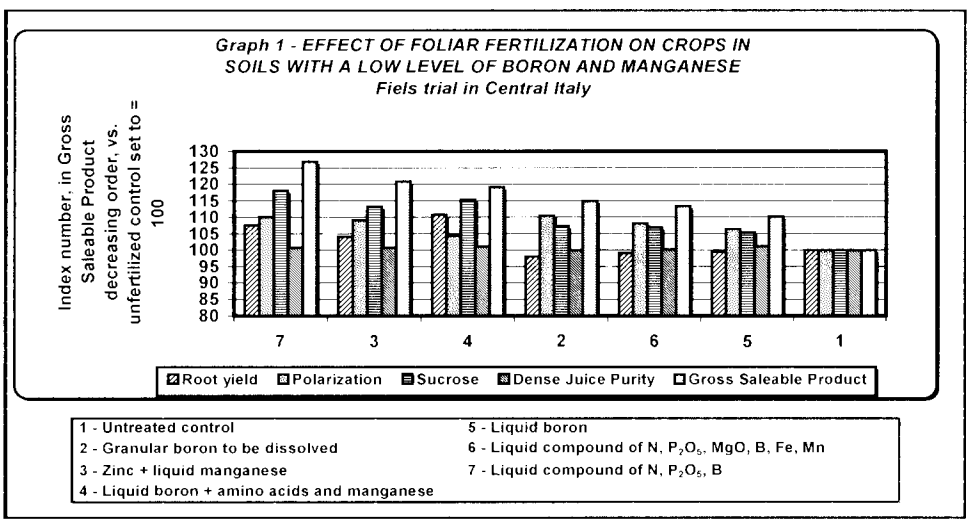
Tests in Central Italy – The test was performed on a terrain having the following characteristics: sand 14%, silt 60%, clay 26%, pH 7.97, total lime 41.4%, active lime 13.9%, organic substances 1.8, N 1.8‰, P_2O_5 51 ppm, exchangeable potassium K_2O 190 ppm, MgO 230 ppm, CaO 4429 ppm, cationic exchange capacity 18 meq/100g, Mn 5.9 ppm, B 0.31 ppm. There was a considerable lack of manganese while boron was at the lower limit (at the farm the "hollow sugar beet core" is particularly widespread).

To perform the plot test an experimental, 4 randomized block model was used with the following 7 treatments: 1) untreated control; 2) granular boron to be dissolved; 3) zinc + liquid manganese; 4) liquid boron + amino acids and manganese; 5) liquid boron; 6) liquid compounds of N, P_2O_5, MgO, B, Fe, Mn; 7) liquid compounds of N, P_2O_5, B. In all tests two treatments were performed: one on May 15th before the plant rows had closed and the other on June 8th when the leaf system had completely closed.

Tests in Northern Italy - The test was performed on a terrain having the following characteristics: sand 6%, silt 54%, clay 40%, pH 7.8, total lime 6.5%, active lime 5.2%, organic substances 2.25%, N 1.7‰, P_2O_5 37 ppm, exchangeable potassium K_2O 235 ppm, MgO 899 ppm, CaO 7681 ppm, cationic exchange capacity 21.4 meq/100 g, Mn 15.2 ppm, B 0.4 ppm. This is, therefore, a normal soil. To perform the plot test an experimental, 4 randomized block model was used with the following 8 treatments: 1) untreated control; 2) zinc + liquid manganese; 3) liquid boron + other microelements; 4) potassium oxide + liquid sulfur dioxide; 5) liquid compound of NPK + microelements; 6) liquid compound of NPK + manganese and zinc; 7) liquid compound containing glucose; 8) liquid compound containing nitrogen and glucose. Tests treatments 2, 3, 4 were applied on May 25th when the leaf system had completely closed the rows and on July 19th; test treatments 5, 6, 7 were performed on June 1st and July 4th; test treatment 8 was applied on July 4th.

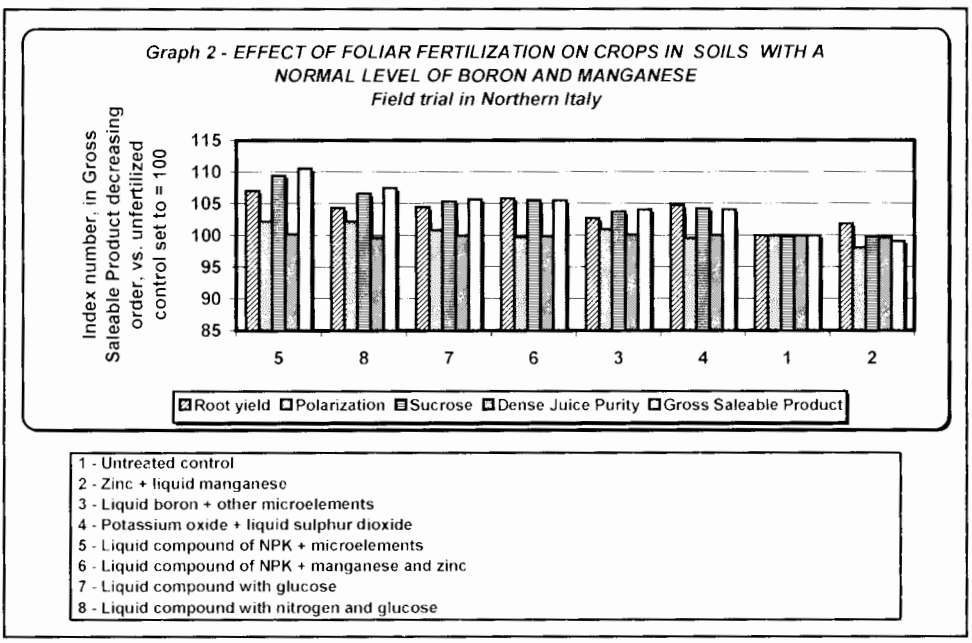
RESULTS

Tests in Central Italy – Analysis of graph 1 shows the gross saleable product values. There is a statistical difference between the tests and the untreated control with increases ranging from 10 to 27%. In terms of sugar content such increases ranged from 5 to 18% although there was no statistically significant difference between the various treatments.



As regards beet yield, although there was a 4 to 10% increase with some of the test treatments, the experiment did not show any statistically significant differences. On the other hand, polarization was statistically different with increases from 5 to 11% vs. the untreated controls. There was no particular difference between the PSD quality (raw juice purity) obtained with the various tests nor was there a great difference in the values of the molasses-producing elements αN, K, Na.

Tests in Northern Italy – While the treated plots showed increases in production yield and quality over the untreated control, analysis of Graph 2 does not show any statistically significant differences. In particular, the increase in beet yield varied between 2 and 7% for the treated areas with maximum gross production values of 11% over the untreated control. As regards polarization, no particular oscillations were found with any of the treatments. On the whole, these values do show the positive effects foliar treatments have on productivity. Moreover, it must be recalled that these tests were performed in soil with a normal supply of elements; in situations of micro-deficiencies, treatment would have a more meaningful effect on productivity.

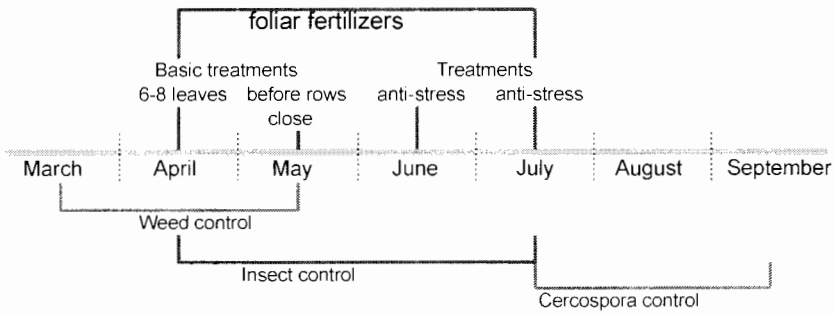


CONCLUSIONS

Natural plant growth takes place through regular photosynthesis. This ensures that the supply of carbohydrates, again provided through photosynthesis, is greater than the losses caused by normal physiological processes (respiration, transpiration, root absorption, etc.). Photosynthesis is facilitated by a valid substrate with an adequate supply water, air and nutrients. Climatic, nutritional or agronomic imbalances can interfere with plant development thus leading to inadequate production yields. Extensive, prolonged rains can leach significant quantities of nutrients such as nitrogen and microelements out of the soil. Moreover, a pH greater than 7.5 and the presence of lime, copper, zinc and iron, can inhibit the absorption of other elements thus leading to deficiencies and inadequate productivity. It is, therefore, extremely important to maintain the proper balance of elements as this facilitates normal photosynthesis which, in turn, can ensure satisfactory production.

The experimental studies performed by ANB indicate that production can be enhanced by foliar administration of fertilizing elements. The periods of

Figure 1 - **FOLIAR FERTILIZATION: PERIODS OF INTERVENTION IN COMBINATION WITH WEED CONTROL AND PHYTOTHERAPY TREATMENTS**



N.B.: do not mix foliar products with mineral oil and cupric compounds

intervention are indicated in figure 1. To prevent "overburdening" production costs, it is advisable to intervene in association with traditional herbicide, insecticide treatments or at the initial application of treatments vs. Cercospora.

The tests performed in boron and manganese depleted soils showed how important it is to apply foliar fertilizers before such deficiencies become manifest: that is, before the rows close and immediately thereafter. In particular, the best increases in sugar production between 15 and 18% have been obtained with those products containing several elements as opposed to those containing just boron.

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