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Response of sugar beet varieties to the soil and foliar nitrogen fertilization

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Abstract: *Response of sugar beet varieties to the soil and foliar nitrogen fertilization.* The influence of the method of nitrogen fertilization on the yield of sugar beet – diploidal PN Mono 1 and triploidal Jamira varieties, was evaluated in 1993–1994 period. Nitrogen was applied in a single rate of 120 kg N/ha before sowing, and 80 kg of N before sowing plus foliar spraying of 40 kg N/ha in a form of 6% urea solution. Higher yield of roots (by 6.5%) and of leaves (by 45.7%) was obtained in case of Jamira variety. Foliar nitrogen fertilization increased yield of beet roots of PN Mono 1 variety by 6.1% and that one of leaves by 15.2%. Jamira variety did not react to the method of nitrogen fertilization.

Key words: varieties of sugar beet, nitrogen fertilization

INTRODUCTION

Due to the greater effect of heterosis, triploidal varieties, dominating in Register of Original Plant Varieties, give higher yield of roots by 10–20 t/ha, higher yield of sugar by 2–4 t/ha and higher sugar content by 0.2–0.3%, as compared to diploidal varieties (COBORU 1991). On the other hand, quality of the seeds of these first varieties is lower what results in weaker field seedlings by 5–8% and in unfavourable conditions – even by 10–15% (Antonow 1987, Czeczot 1987). Besides the quality of the seeds, the seedlings of the plants and their final density are affected by the level of nitrogen rate, date and the way (technique) of its application. High rates of nitrogen, being applied directly before sowing, affect negatively the field seedlings what limited the target sowing of the plants. On the other hand, the division of the rate into pre-sowing and dressing doses, in a form of solid fertilizers, contributes to the decrease of its effectiveness and utilization by the plants (Gutmański 1991). The post-sowing nitrogen fertilization affect the increase of the yield of the leaves and deteriorates the processing value of the roots (Kalinowska-Zdun et al. 1986). Another method of fertilization is foliar spraying of nitrogen to the plants in a form of 6% urea solution (Czuba, Górecki 1990). Such system of fertilization gives the possibility to interfere in the mechanism of the plant's photosynthesis and it stimulates its greater crop.

Foliar fertilization is especially effective during the period of drought when the plant is not able to absorb the nutrients via the roots (Gutmański 1991). It refers to macro- as well as microelements. The effects of foliar fertilization of beets with urea together with microelements are little known and therefore they are the subject of the present work.

METHODS AND CONDITIONS OF THE EXPERIMENTS

In the field experiment, arraged in 1993–1994 by the split-plot method in four repetitions, the effects of nitrogen fertili-

zion of sugar beet of two varieties (diploidal – PN Mono 1 and triploidal – Jamira), were evaluated. Nitrogen in the dose of 120 kg/ha in a form of ammonium nitrate was applied to the soil before sowing and as the soil and foliar spraying, i.e. 80 kg N/ha before sowing in a form of ammonium nitrate and 40 kg N as foliar application in a form of 6% urea solution. The plants were fertilized 5 times, in the time intervals of 7–10 days; in 3 sprayings, the addition of Insol 4 in dose of 3 l/ha, was applied. The surface of the plot amounted to 15 m^2. In the experiment, the number of the plants was determined after seedlings and after thinning; the yield of roots and leaves was determined in the harvesting period. Before harvesting, the measurements of the number and surface of the leaves, fresh and dry matter of the plant leaves were performed on the grounds of 20 plants or samples from we combination. The presented results are the mean values from this number of the plants.

The experiment was conducted on the degraded black earth of very good, rye complex, with bonitation class IIIb, pH 6.4. The abundance in nutritive elements in this soil was average. The operations were performed acc. to the agrotechnical recommendations of IUNG (Institute for Soil Science, Fertilization and Cultivation). The length of the vegetation period was 173–179 days.

During the first year of the studies, in the vegetation period, the precipitation amounted to 227 mm, with their considerable deficiency in the particular months in relation to the demand of the plants. The sum of temperatures, reaching to 3167°C, exceeded considerably the optimal temperature acc. to Haberland, i.e. 2600–2700°C. During the second year, the precipitation were greater (384 mm), especially in April and May, and during the remaining months it was similar. The sum of temperatures was somewhat higher – 3300°C.

RESULTS

The number of the plants after seedlings and thinning did not differ significantly between the beet varieties, however it was higher in case of diploidal variety PN Mono 1 and amounted to 166 and 128 thous./ha, respectively. On the other hand, the number of the plants during the harvesting period, being equal to 93.9 for diploidal variety and 73.4 thous./ha for triploidal variety, differed as much as by 21.8%. It was a result of considerably higher losses of plants of triploidal variety during the vegetation period (27% for 2 × and 37.2% for 3 ×). The method of fertilization did not differentiate significantly the density of the plants.

The number of leaves and their surface were significantly higher in triploidal variety Jamira by 19.8 and 40.2%, respectively (Fig. 1). In case of this variety, fresh and dry matter of the roots was also higher by 13.8% and 9.2%, that one of stalks by 42.2 and 30.4% and that one of leaf blades by 43.1 and 35.8% (Fig. 2 A and Fig. 2 B). In connection with this fact, the yields of the roots, and especially of the leaves were significantly higher (by 45.7%) in Jamira variety (Fig. 3).

The soil nitrogen fertilization has contributed to significant increase of the number and surface of the leaves (Fig. 4) and fresh and dry mass of the leaves (Fig. 5 A and B), as compared to the rate, divided into the soil and foliar doses. Fresh and dry matter of leaf stalks, as affected by the soil fertilization demonstrated only the increasing tendency. On the other hand, fresh and dry matter of the roots was

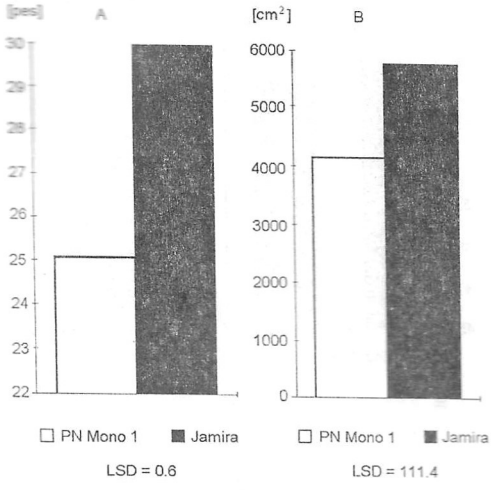

FIG. 1. Number of leaves in the plant in pcs (A) and surface of leaf blades in cm^2 (B) in two varieties of sugar beet

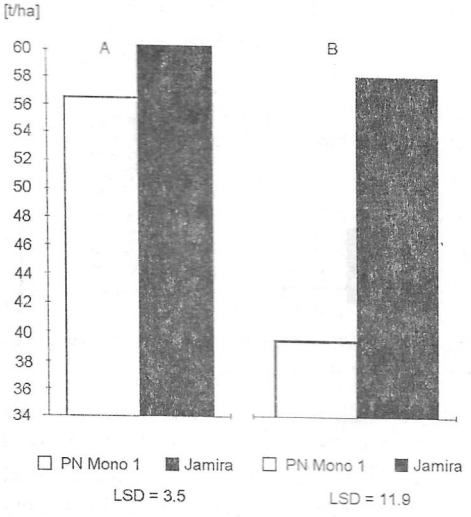

FIG. 3. Yield of the roots (A) and of leaves (B) in t/ha in two varieties of sugar beet

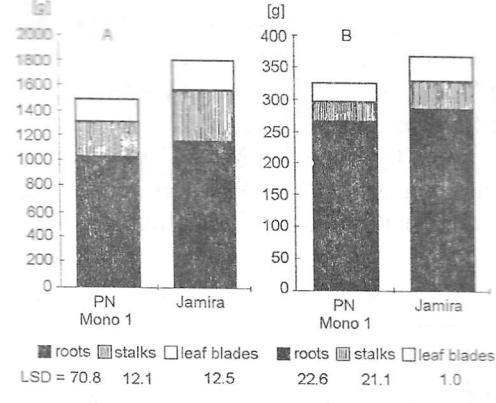

FIG. 2. Fresh (A) and dry (B) matter and plants in g in two varieties of sugar beet

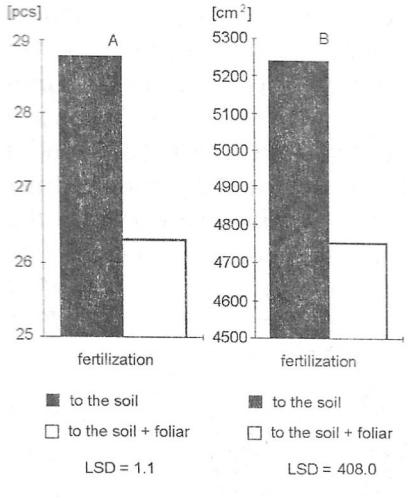

FIG. 4. Number of leaves in pcs/plant (A) surface of leaf blades of one plant in cm^2 (B) depending on fertilization

somewhat higher in case of the foliar fertilization. Division of nitrogen rate into the soil and foliar doses has also contributed to the increase of the yield of the roots (Fig. 6A) and of leaves (Fig. 6B).

The response of the varieties to fertilization was differentiated. The number of leaves was higher in Jamira variety, usually irrespectively of the method of fertilization (Fig. 7A). On the other hand, the surface of the leaves differed between the varieties in case of the soil fertilization by 32,5% and in the soil + foliar fertilization

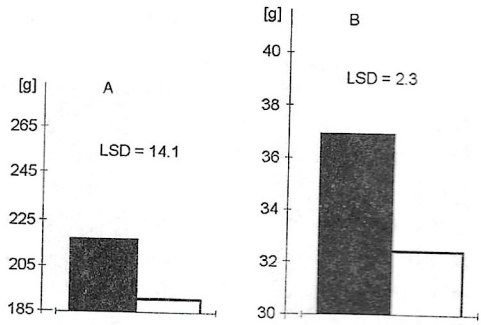

FIG. 5. Fresh (A) and dry (B) mass of leaves of one plant in g depending on fertilization

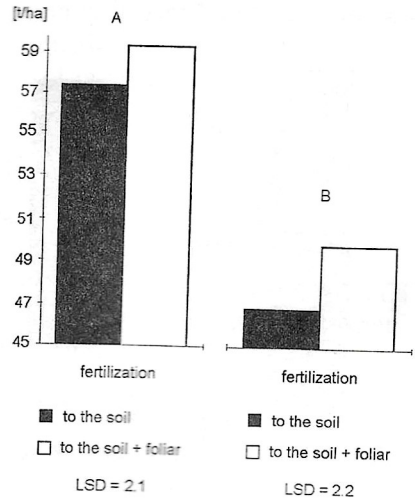

FIG. 6. Yield of roots (A) and of leaves (B) in t/ha depending on fertilization

as much as by 49,2% on favour of Jamira variety (Fig. 7B). It is an evidence that foliar nitrogen fertilization of the plants affected, to a greater degree, the value of this property in triploidal Jamira variety. Diploidal variety PN Mono 1 reacted to the foliar fertilization by the considerable decrease of the leaves surface by 15.4%. In case of Jamira variety, the method of fertilization did not differentiate this property.

The soil fertilization did not differentiate fresh (Fig. 8A) and dry matter of the roots of the examined varieties. On the other hand, soil and foliar fertilization contributed to the increase of the fresh (by 20.8%) and dry matter (by 11.9%) of the root in Jamira variety, in comparison to PN Mono 1 variety. The soil + foliar fertilization caused lowering the dry matter of roots by 7% in PN Mono 1 variety and the increase by 10.3% in Jamira variety, as compared to the soil fertilization.

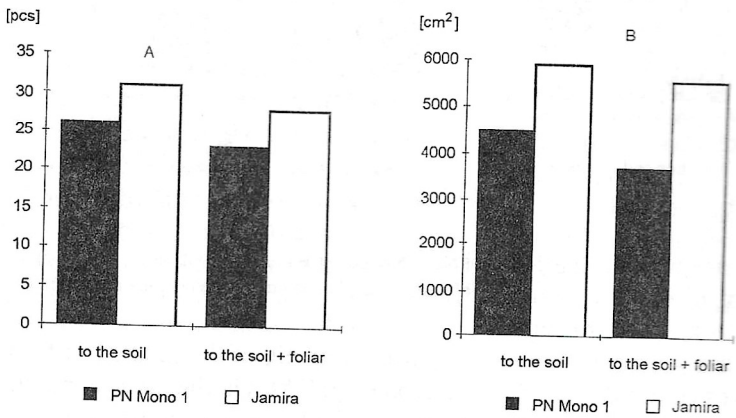

FIG. 7. Number of leaves on the plant in pcs (A, LSD A/B = 1.2 B/A = 1.6) and surface of leaf blades in cm^2 (B, LSD A/B = 419.4, B/A = 574.7) depending on the variety and fertilization

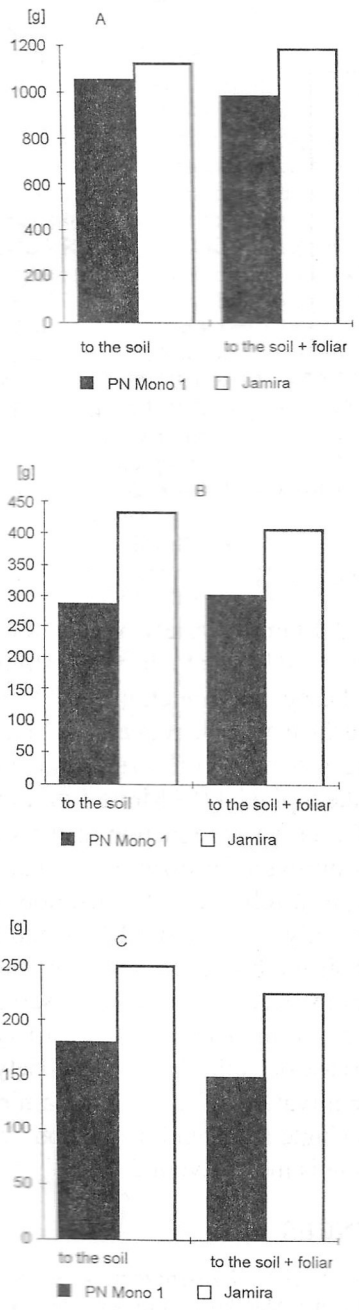

FIG. 8. Fresh mass of the root (A, LSD A/B = 89.7 B/A = = 90.8), leaf stalks (B, LSD A/B = 28.1 B/A = 36.8) and leaf blades (C, LSD A/B = 17.8 B/A = 19.6) of one plant in g depending on the variety and fertilization

In the soil fertilization, the fresh mass of leaf stalks was higher by 50.5% in Jamira variety and in the soil + foliar fertilization, it was higher by 34.4%, in comparison to PN Mono 1 (Fig. 8B). Similar relationship occurred in case of dry matter of stalks but the differences were smaller and they amounted to 13.6% and 12.4%, respectively. In PN Mono 1 variety fresh and dry matter of leaf stalks was somewhat higher at the divided N rate, and in Jamira variety it was lower, i.e. in case of fresh mass of the stalks by 5.2% (Fig. 8B) and dry matter by 7.3%.

In the soil fertilization fresh mass of leaves was higher by 37.2% in Jamira variety and in the soil + foliar fertilization by 50% (Fig. 8C). In relation to dry matter of leaves, the differences amounted to 12.6 and 14.7%, respectively. Thus, the division of the nitrogen rate has contributed to much greater extent to the growth of surface and mass of the leaves than to that one of the leaf stalks in Jamira variety. PN Mono 1 variety reacted to the division of N dose by lowering of fresh mass by 16.2% and of dry matter of leaves by 18.3% whereas in case of Jamira variety, the method of fertilization did not have any significant meaning.

In the soil nitrogen fertilization, the yield of the roots (Fig. 9A) was higher by 9.1% and the crop of the leaves was higher by 57.2% (Fig. 9B) than in PN Mono 1 variety. The division of N dose has an influence on the small increase of the crop of roots in this variety but it caused a considerable rise of the leaves yield (by 30.9%). The higher yield of the roots and leaves was obtained in case of PN Mono 1 variety at the soil and foliar fertilization (by 6.1 and 15.2%) while Jamira variety did not react to the method of fertilization.

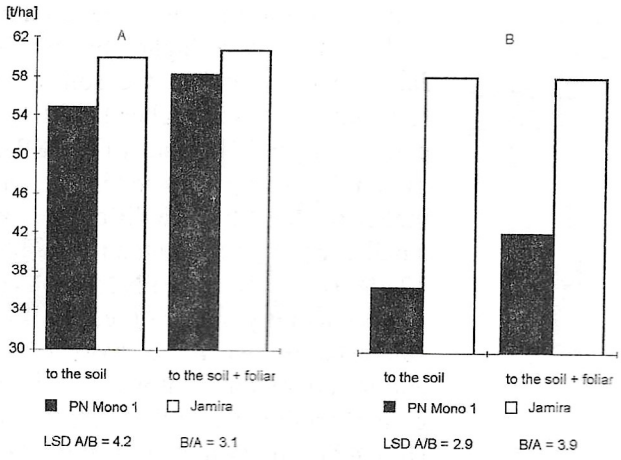

FIG. 9. Yield of the roots (A) and of leaves (B) in t/ha depending on the variety and fertilization

DISCUSION

The studies revealed small differentiation of field shooting up depending on the variety and big losses of the plants during the vegetation period in triploidal Jamira variety. The differences between the varieties in the yield of the roots, and especially of leaves were greater than it was indicated by the data of COBORU (1991) and by Siódmak, Heimonn (1994). Fresh and dry matter of leaf stalks and leaf blades of triploidal variety was extremely high. The effect of foliar urea fertilization of the plants, in combination with Insol, occurred to be smaller than our expectations and conclusions of other authors (Czuba 1988; Czuba, Górecki 1990). Nitrogen fertilization affected principally only the diploidal PN Mono 1 variety, yielding the greater crop of the roots at the soil and foliar urea fertilization of the plants. The obtained results are interesting due to the lack of the data in literature, concerning the reactions of various varieties to the foliar urea fertilization together with the microelements.

CONCLUSIONS

1. Triploidal Jamira variety of sugar beet is characterized by the higher yield of the roots, and especially much greater number and surface of the leaves and the mass of the overground part (leaves), as compared to the diploidal PN Mono 1 variety.

2. Different way of reaction of the varieties to nitrogen fertilization indicates the purposeful foliar urea fertilization of the plants only in diploidal PN Mono 1 variety. This method of fertilization does not cause any excessive gain in the surface and mass of the leaves in this variety, such as in case of triploidal Jamira variety.

3. In cultivation of triploidal Jamira variety, a single nitrogen fertilization before sowing is more favourable.

REFERENCES

ANTONOW J. 1987: Dziedziczenie niektórych cech u buraka. Mat. konf. „Problemy hodowli i nasiennictwa buraka cukrowego". Kalisz; 64–65.

CZECZOT L. 1987: Produkcja nasienna buraka cukrowego w Polsce. Mat. konf. „Problemy

hodowli i nasiennictwa buraka cukrowego". Kalisz; 17–26.
COBORU 1991: Wiadomości odmianowe. Analiza postępu w hodowli roślin uprawnych w Polsce w 1986–1990. 43; 22–24.
CZUBA R. 1988: Efekty dolistnego dokarmiania roślin roztworem mocznika i mikroelementami zbóż, rzepaku i buraków cukrowych. Mat. Seminarium Naukowego. Puławy; 33–39.
CZUBA R., GÓRECKI K. 1990: Zespolone metody dokarmiania i ochrony buraka cukrowewgo. Wyd. IUNG Puławy, Ser. P (47); 7–39.
GUTMAŃSKI I. (red.) 1991: Produkcja buraka cukrowego. PWRiL, Warszawa; 300–312.
KALINOWSKA-ZDUN M., POLUBIEC E., PODLASKA J. 1986: Wpływ nawożenia azotem, przedsiewnej uprawy roli i nawadniania na obsadę roślin, plon i wartość technologiczną korzeni buraków cukrowych. *Rocz. Nauk Rol. A*, 106; 45–62.
SIÓDMAK J., HEIMONN J. 1994: Synteza wyników doświadczeń odmianowych. Burak cukrowy. COBORU 1009; 12–14.

Streszczenie: *Reakcja odmian buraka cukrowego na doglebowe i dolistne nawożenie azotem.* W latach 1993–1994 oceniano wpływ sposobu nawożenia azotem na plonowanie buraka cukrowego odmiany diploidalnej PN Mono 1 i triploidalnej Jamira. Azot stosowano w dawce 120 kg N/ha jednorazowo przed siewem oraz 80 kg N przedsiewnie i 40 kg N/ha dolistnie w formie 6% roztworu mocznika. Rośliny dokarmiano pięciokrotnie, co 7–10 dni. W trzech opryskach zastosowano dodatek Insolu w dawce 3 l/ha. Wyższy plon korzeni o 6.5% i liści o 45.7% dała odmiana Jamira. Na sposób nawożenia azotem reagowała w zasadzie tylko odmiana diploidalna PN Mono 1, dając większy plon korzeni o 6.1%, a liści o 15.2% przy doglebowym i dolistnym nawożeniu roślin mocznikiem, w porównaniu z jednorazową dawką azotu wniesioną przedsiewnie. Brak reakcji odmiany Jamira na sposób nawożenia uzasadnia zastosowanie pełnej dawki azotu przed siewem.

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