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# Possibility of Using Compost as A Partial Substitute for Mineral Nitrogen Fertilizer and Evaluating This on Performance of Sugar Beet Plants Sprayed with Boron from Different Sources.

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## ABSTRACT

Two field experiments were conducted at Dakahlia., Egypt during 209/2020 and 2020/2021 seasons to evaluate the response of sugar beet to boron spraying (Control, 1.0 mg B as Milano [15 %boron]/15 L water, 2.0 mg B as Milano 15 %boron/15 L water, 0.5 g B as borax 11%boron /15 L water, 1.0 g B as borax 11%boron /15 L water, 0.5 g B as boric acid 17%boron/15 L water and 1 g B as boric acid 17%boron /15 L water ) and combinations of compost with mineral nitrogen fertilizer (100% N mineral nitrogen, 75 mineral N + 25 % compost, 50 mineral N + 50 % compost, 25 mineral N + 75 % compost and 100% N as compost.). Split plot design in 3 replications was used where, the N sources were attributed at the main plots while, the sub plots included boron treatments. The results showed that 100% N mineral nitrogen was superior treatment compared with the other N treatments, as well as spraying B at rate of 1.0 g 15 L-1 as boric acid came in the first order compared with the other B treatments. On the other hand, the plants received 75 mineral N + 25 % compost and sprayed by Boron from any source and by any rate recorded the better responses compared with plants received 100% N mineral nitrogen as mineral fertilizer without B application.

***Keywords:*** Sugar beet, sustainable agricultural development, boron element, N-fertilizer and compost.

## INTRODUCTION

Sugar beet (*Beta vulgaris* L.) yield and quality are important issues for farmer's income in Egypt, where it consider an important position as a winter crop in crop rotation in Egypt. Presently, the Egyptian Government strategy aims at reducing the gap between the consumption and production of sugar so it encourages sugar beet growers to increase the cultivated area (Leilah *et al.*, 2017). Presently, some research works has proven that chemical nitrogen fertilizers are related to the increases in impurities content in sugar beet (Faiyad and Hozayn, 2020).

Even though the mineral nitrogen fertilizers are essential to high plant growth, the continued utilization of chemical fertilizers *eg.*, urea and ammonium nitrate causes environmental and health hazards and thereby reducing the amount of mineral nitrogen fertilizers applied to the field without nitrogen deficiency will be the biggest challenge in the agricultural sector (Seadh, 2014).

Compost improves the environmental sustainability of agriculture via decreasing chemical inputs (Safina and Fatah, 2011), where it is a rich source of nutrients *e.g.*, N, P, K, S with high organic matter content, thus soil addition of compost before cultivation is beneficial to improve soil fertility status, where biological, physical and chemical attributes of soil can be enhanced as a result of compost addition, which may ultimately increase total and cumulative crop yields (Ilupeju, 2015).

The boron is considered as the second most vital micronutrients constraints in crop production after zinc. It is plays a vital role in sugar transport, cell division, cell-wall synthesis, differentiation, root elongation, membrane functioning, regulation of plant hormone levels, and generative growth of plants (El-Sherpiny, 2016). Currently, there is an increase in the sugar beet fields, which have appeared boron deficiency symptoms. In beginning sugar beets life, Boron deficiency symptoms occur as wilting of leaves or a white netted chapping of the upper blade surfaces. Later, if the deficiency becomes severe, transverse cracking of the petioles develops and the new leaves in the growing point may turn black as mentioned by Kristek *et al.* (2006) and El Hamdi *et al.* (2017) they reported that correcting or preventing the B deficiency through B addition either by soil or foliar applications can improve yield and sugar content, there is still a lack of information on the effect of boron application on sugar beet yield and quality particularly under Egyptian condition.

Finally, N management is key to achieving profitable sugar beet yield and quality. When synthetic fertilizers price increases, producers often consider alternatives sources as organic fertilizers (compost) and foliar applications of different boron sources may be enhance yield and quality of sugar beet plants. Therefore, the objective of this study was to assess the t effect of boron spraying and combinations of compost and mineral nitrogen fertilizer on sugar beet productivity and their interactions on

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some physiological characters, productivity and quality of sugar beet under the condition of dakahlia., governorate, Egypt.

## MATERIALS AND METHODS

**1.Experimental site:**

Two field trials were done for the period of 2019/20 and 2020/21 seasons at a private farm located in El-Shaarawi Village, Belqas District, Dakahlia Governorate, Egypt.

**2.Soil sampling:**

Soil sample taken at depth of 0-30 cm before sowing at both studied seasons were analyzed according to Dane and Topp (2020) and Sparks *et al.* (2020) as shown in Table1.

**3.Compost used:**

The analysis of compost (animal residues) is presented in Table 2.

**Table 1. Characteristics of initial soil before sowing at both seasons.**

| Initial soil characteristics | | Values First season (2019/20) | Values Second season (2020/21) |
|---|---|---|---|
| Particle size distribution (%) | C. sand | 2.200 | 2.500 |
| | F. sand | 19.30 | 19.00 |
| | Silt | 28.30 | 28.60 |
| | Clay | 50.20 | 49.90 |
| Textural class | | Clay | |
| EC $dSm^{-1}$ | | 1.470 | 1.570 |
| $pH^{**}$ | | 8.130 | 8.070 |
| $CaCO_3$ % | | 2.130 | 2.170 |
| Organic matter, % | | 0.990 | 1.150 |
| Field capacity ,% | | 34.50 | 35.00 |
| Saturation,% | | 69.00 | 70.00 |
| Available macro-nutrients, $mgKg^{-1}$ | Nitrogen | 61.59 | 66.59 |
| | Phosphorus | 10.50 | 11.30 |
| | Potassium | 235.3 | 243.9 |
| Available boron, , $mgKg^{-1}$ | | 0.500 | 0.700 |

**Table 2. Chemical analysis of compost used.**

| pH 1:10 | EC (1:10) ($dSm^{-1}$) | O.M (%) | O.C (%) | N (%) | C/N ratio | P (%) | K (%) | Mg (mg $kg^{-1}$) | Fe (mg $kg^{-1}$) | Cu (mg $kg^{-1}$) | Zn (mg $kg^{-1}$) | Cd (mg $kg^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.67 | 4.10 | 32.0 | 19.08 | 1.22 | 15.7 | 0.42 | 0.66 | 26.4 | 62.3 | 5.56 | 18.43 | 1.05 |

**4. Experimental Design and Treatments:**

The trial was hold out in a split-plot design with treatments total number of 35 with three replicates (5 N sources x 7 B treatments x 3 replicates = 105), where the experimental unit was 84.0 $m^2$ (12.0 m × 7.0 m) for each main plot, which contained 7.0 ridges (0.85 m wide and 12.0 m long). Each ridge was divided into 3 replicates (4.0 m for each replicate).

**Main plots were N-fertilization sources as follows:**

$T_1$:100% (NRD) of nitrogen recommended dose as mineral fertilizer

$T_2$: 75% of NRD as mineral fertilizer + 25% of NRD as compost.

$T_3$: 50% of NRD as mineral fertilizer + 50% of NRD as compost.

$T_4$: 25% of NRD as mineral fertilizer + 75% of NRD as compost.

$T_5$: 100% of NRD as compost.

**Sub main plots were boron treatments as follows:**

$B_1$: Control (without boron).

$B_2$: Boron at rate of 1.0 mg B 15 $L^{-1}$ water using Milano [15 %boron].

$B_3$: Boron at rate of 2.0 mg B 15 $L^{-1}$ water using Milano [15 %boron].

$B_4$: Boron at rate of 0.5 g B 15 $L^{-1}$ water using borax [11%boron].

$B_5$: Boron at rate of 1.0 g B 15 $L^{-1}$ water using borax [11%boron].

$B_6$: Boron at rate of 0.5 g B 15 $L^{-1}$ water using boric acid [17%boron].

$B_7$: Boron at rate of 1.0 g B 15 $L^{-1}$ water using boric acid [17%boron].

**5.Cultivation:**

Seeds of sugar beet (C.v. Finoget) were obtained from the Sugar Res. Institute, Agriclutural Research Center (ARC), Egypt, sowing date was in $19^{th}$ of October in both seasons at rate of 3-4 balls $hill^{-1}$ in one side of the ridge with distance of 20 cm among the plants, then the thinning was at 30 and 45 days from sowing aiming at ensuring one plant $hill^{-1}$ (almost 35000 plants $fed^{-1}$). All plots received calcium superphosphate during soil preparation before sowing (100 kg $fed^{-1}$, 15% $P_2O_5$). Also, compost was added at the above-mentioned rates during soil preparation before sowing. Irrigation process was done immediately after sowing. Urea (46.5%N) was used for N fertilization, where it was applied with the above-mentioned rates at two equal doses; the $1^{st}$ was done after thinning, while the $2^{nd}$ was done after one month later. On the other hand, potassium fertilization was added using potassium sulfate (48 % $K_2O$) at rate of 50.0 kg $fed^{-1}$ with the $1^{st}$ dose of urea. All boron sources were purchased from El-Gamhoria Company, Egypt, and then studied boron solutions at investigated rates were prepared. The first foliar application of B treatments was implemented after 70 days from cultivation and repeated two times with two weeks interval. It is also worth noting that all traditional agricultural practices were done.

**6.Measurements parameters:**

**First stage (at 90 days from sowing).**

Using five plants from every treatment, chlorophyll content (SPAD reading value) and chemical constituents *i.e.,* N (using Kjeldahl method), P(using spectrophotometer), and K (using flam photometer) in sugar beet foliage were determined after completely wet digested according to Walinga *et al*., (2013).

**Second stage (maturity stage, 180 days from sowing).**

Samples of five plants were taken and carefully uprooted for estimating top and root fresh weights (g $plant^{-1}$ and ton $fed^{-1}$) as well as root length and diameter (cm).

**7.Statistical analysis***:*

The obtained data were subjected to analysis of variance according to [Gomez and Gomez (1984), Treatment means were compared by using least significant difference (LSD) at 0.05 level of probability, all statistical analysis was performed using analysis of variance technique by means of CoStat computer software package (Version 6.303, CoHort, USA, 1998–2004).

## RESULTS AND DISCUSSION

**1. Plant performance at the first stage:**

Data in Tables 3 and 4 show the impact of combined application of mineral nitrogen fertilizer and compost at different ratios with foliar applications of different boron sources at different rates and their interactions on sugar beet performance expressed in total N, P and K contents in leaves at a period of 90 days from sowing as well as chlorophyll content (SPAD reading value) during both growing seasons of 2019/20 and 2020/21.

**Individual effect:**

Data in Table 3 illustrate that different studied ratios between both urea and compost significantly affected N,P,K and chlorophyll content values, where the superior treatment was **$T_1$** treatment (100 % of NRD as urea) followed by **$T_2$** treatment (75% of NRD as urea +25 % compost) then **$T_3$** treatment (50% of NRD as urea +50 % compost) followed by **$T_4$** treatment (25% of NRD as urea +75 % compost) and lately **$T_5$** treatment (100 % of NRD as compost). The same trend was found for both studied seasons.

The superiority of $T_1$ treatment (100 % of NRD mineral nitrogen as urea) compared to others combined treatments of mineral nitrogen as urea (at rate of 75, 50,25 and 0.0 % of NRD) and compost (at rate of 25,50,75,100% of NRD) may be attributed to that urea contains nitrogen in form of amide which fast turn into available N forms to plants ($NH_4^+$ and $NO_3^-$) in addition to urea is not possessed osmotic pressure thus, this reason made the plants absorbed mineral N fast than organic N in compost which needs a long period to turn into available N forms to plants ($NH_4^+$ and $NO_3^-$) through some processes *e.g*,. ammonification and nitrification (Barker and Bryson, 2016). Even though the ease of plant absorption to mineral N from studied synthetic fertilizer (urea) compared to organic N from studied compost, the compost had a vital role in supplying nutrients to sugar beet plants, where it contained many essential nutrient elements that are associated with improving photosynthetic efficiency, physiological and meristematic activities in the plants. In addition to its ability in improving soil fertility status and this led to enhancing the performance of sugar beet plants (Manirakiza and Şeker, 2020)

**Table 3. Effect of different combination between mineral nitrogen with compost and foliar application of boron sources on chemical constituents of sugar beet shoots at both 90 days after sowing during the tow growing seasons 2019/20 and 2020/21.**

| Treatments | N, % | | P, % | | K, % | | Chlorophyll, SPAD | |
|---|---|---|---|---|---|---|---|---|
| | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Nitrogen fertilization ratios (mineral + compost) | | | | | | | | |
| $T_1$: 100 % of NRD as urea | 3.09a | 3.15a | 0.367 | 0.376a | 3.93a | 4.09a | 41.85a | 42.64a |
| $T_2$: 75% of NRD as urea +25 % compost | 2.90b | 2.96b | 0.341 | 0.349b | 3.65b | 3.78b | 41.06b | 41.94b |
| $T_3$: 50% of NRD as urea +50 % compost | 2.61c | 2.67c | 0.299 | 0.307c | 3.22c | 3.35c | 39.43c | 40.34c |
| $T_4$: 25% of NRD as urea +75 % compost | 2.32d | 2.37d | 0.261 | 0.267d | 2.81d | 2.92d | 37.98d | 38.81d |
| $T_5$: 100 % of NRD as compost | 2.00e | 2.06e | 0.217 | 0.222e | 2.38e | 2.47e | 36.28e | 37.08e |
| LSD at 5% | 0.03 | 0.02 | 0.002 | 0.002 | 0.03 | 0.02 | 0.24 | 0.17 |
| Foliar application | | | | | | | | |
| $B_1$: Control (without B) | 2.43f | 2.50g | 0.274g | 0.281f | 2.96g | 3.08g | 38.48e | 39.35e |
| $B_2$: Rate of 1.0 mg B 15 $L^{-1}$ as Milano | 2.59d | 2.63d | 0.298d | 0.305c | 3.21d | 3.33d | 39.37bcd | 40.17bc |
| $B_3$: Rate of 2.0 mg B 15 $L^{-1}$ as Milano | 2.63c | 2.70c | 0.303c | 0.313b | 3.26c | 3.39c | 39.55abc | 40.45ab |
| $B_4$: Rate of 0.5 g B 15 $L^{-1}$ as borax. | 2.52e | 2.57f | 0.288f | 0.294e | 3.10f | 3.22f | 38.98d | 39.73de |
| $B_5$: Rate of 1.0 g B 15 $L^{-1}$ as borax. | 2.57e | 2.60e | 0.293e | 0.299d | 3.16e | 3.27e | 39.15cd | 39.97cd |
| $B_6$: Rate of 0.5 g B 15 $L^{-1}$ as boric acid. | 2.67b | 2.72b | 0.308b | 0.315b | 3.31b | 3.44b | 39.76ab | 40.61a |
| $B_7$: Rate of 1.0 g B 15 $L^{-1}$ as boric acid. | 2.71a | 2.79a | 0.314a | 0.322a | 3.37a | 3.50a | 39.95a | 40.86a |
| LSD at 5% | 0.03 | 0.02 | 0.003 | 0.003 | 0.03 | 0.03 | 0.42 | 0.41 |

Our findings are in accordance with those of El-Mantawy *et al.,* (2021) they reported possibility of using compost as a partial substitute for mineral nitrogen fertilizer with maize plants.

Concerning boron treatments, it can be noticed that all treatments of boron sources at all studied rates positively affected N, P, K and chlorophyll content values compared to corresponding plants grown without boron foliar application. On the other hand, the best boron source was boric acid, while the commercial product named Milano came in the second ranking followed by borax. Also, it can be noticed that the values of all aforementioned traits increased as the B rate increased. On other words, the sequence rank of B treatment from the most effective to less was as follows; $B_7 > B_6 > B_3 > B_2 > B_5 > B_4 > B_1$. The same trend was found for both studied seasons.

The positive role of boron may be attributed to its role in sugar transport, cell division, cell-wall synthesis, differentiation, root elongation, membrane functioning, regulation of plant hormone levels, and generative growth of plants (El-Sherpiny, 2016). These findings closely agree with those of Ibrahim *et al*., (2020) who reported that spraying sugar beet plants with boron at the rate of 100 mg $L^{-1}$ was more effective compared to plants untreated (control) in increasing chemical constituents values in leaves and general performance of plant.

**Interaction effect:**

Data in Table 4 show that plants received 100% of NRD as mineral nitrogen in form of urea and simultaneously sprayed with B at rate of 1.0 g 15 $L^{-1}$ of water as boric acid came in the first rank compared to other combination treatments. On the other hand, the plants received 75 % of NRD as mineral nitrogen in form of urea plus 25% of NRD as compost and simultaneously sprayed with B from any source at any rate improve sugar beet performance expressed in total N, P, K (%) and chlorophyll content (SPAD reading value), the contents in leaves at 90 days after sowing better than the corresponding plants received 100 % of NRD as mineral nitrogen in form of urea without B application.

**Table 4. Interaction effect among studied treatments on chemical constituents of sugar beet shoots at 90 days after sowing during growing seasons 2019/20 and 2020/21.**

| Treatments | | N, % | | P, % | | K, % | | Chlorophyll, SPAD | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $T_1$: 100 % urea | $B_1$: Control (without B) | 2.82jk | 2.90k | 0.327kl | 0.334hi | 3.50lm | 3.64ij | 40.52g-j | 41.31e-h |
| | $B_2$: Rate of 1.0 mg B 15 $L^{-1}$ as Milano | 3.12bcd | 3.18cd | 0.371cd | 0.379b | 3.97cd | 4.13b | 41.97a-d | 42.80abc |
| | $B_3$: Rate of 2.0 mg B 15 $L^{-1}$ as Milano | 3.15abc | 3.21bc | 0.376bc | 0.389a | 4.03bc | 4.21a | 42.15abc | 42.84abc |
| | $B_4$: Rate of 0.5 g B 15 $L^{-1}$ as borax. | 3.06de | 3.12ef | 0.364ef | 0.371cd | 3.87ef | 4.04c | 41.79a-e | 42.56a-d |
| | $B_5$: Rate of 1.0 g B 15 $L^{-1}$ as borax. | 3.08cde | 3.13de | 0.368de | 0.374bc | 3.93de | 4.08bc | 41.89a-d | 42.66abc |
| | $B_6$: Rate of 0.5 g B 15 $L^{-1}$ as boric acid. | 3.19ab | 3.26ab | 0.380ab | 0.390a | 4.07ab | 4.24a | 42.26ab | 43.11ab |
| | $B_7$: Rate of 1.0 g B 15 $L^{-1}$ as boric acid. | 3.22a | 3.28a | 0.385a | 0.393a | 4.12a | 4.27a | 42.38a | 43.18a |
| $T_2$: 75% urea +25 % compost | $B_1$: Control (without B) | 2.77kl | 2.85lm | 0.321l | 0.328ij | 3.45m | 3.58j | 40.44hij | 41.26fgh |
| | $B_2$: Rate of 1.0 mg B 15 $L^{-1}$ as Milano | 2.91ghi | 2.94jk | 0.342hi | 0.350g | 3.66ij | 3.78fg | 41.06d-h | 42.02c-f |
| | $B_3$: Rate of 2.0 mg B 15 $L^{-1}$ as Milano | 2.94fgh | 3.00hi | 0.345h | 0.358f | 3.70hi | 3.84ef | 41.24c-h | 42.21b-e |
| | $B_4$: Rate of 0.5 g B 15 $L^{-1}$ as borax. | 2.84ijk | 2.90k | 0.332jk | 0.338h | 3.55kl | 3.70hi | 40.77f-i | 41.67d-g |
| | $B_5$: Rate of 1.0 g B 15 $L^{-1}$ as borax. | 2.87hij | 2.96ij | 0.336ij | 0.341h | 3.61jk | 3.73gh | 40.89e-i | 41.74d-g |
| | $B_6$: Rate of 0.5 g B 15 $L^{-1}$ as boric acid. | 2.98fg | 3.04gh | 0.352g | 0.362ef | 3.76gh | 3.88e | 41.44b-g | 42.16c-f |
| | $B_7$: Rate of 1.0 g B 15 $L^{-1}$ as boric acid. | 3.01ef | 3.07fg | 0.358fg | 0.366de | 3.81fg | 3.96d | 41.58a-f | 42.54a-d |
| $T_3$: 50% urea +50 %compost | $B_1$: Control (without B) | 2.49pq | 2.56pq | 0.284r | 0.291m | 3.07r | 3.20o | 38.78m-p | 39.70klm |
| | $B_2$: Rate of 1.0 mg B 15 $L^{-1}$ as Milano | 2.61no | 2.64o | 0.299op | 0.310k | 3.23p | 3.36mn | 39.49klm | 40.27i-l |
| | $B_3$: Rate of 2.0 mg B 15 $L^{-1}$ as Milano | 2.66mn | 2.74n | 0.305no | 0.313k | 3.27op | 3.41lm | 39.59j-m | 40.59h-k |
| | $B_4$: Rate of 0.5 g B 15 $L^{-1}$ as borax. | 2.54op | 2.59p | 0.290qr | 0.295lm | 3.12qr | 3.23o | 38.98l-o | 39.77klm |
| | $B_5$: Rate of 1.0 g B 15 $L^{-1}$ as borax. | 2.57o | 2.60op | 0.294pq | 0.301l | 3.16q | 3.30n | 39.26k-n | 40.07j-m |
| | $B_6$: Rate of 0.5 g B 15 $L^{-1}$ as boric acid. | 2.70m | 2.75n | 0.309mn | 0.316k | 3.33no | 3.45kl | 39.81jkl | 40.91g-j |
| | $B_7$: Rate of 1.0 g B 15 $L^{-1}$ as boric acid. | 2.72lm | 2.84m | 0.314m | 0.325j | 3.37n | 3.50k | 40.09ijk | 41.04ghi |
| $T_4$: 25% urea +75 % compost | $B_1$: Control (without B) | 2.22uv | 2.29st | 0.245x | 0.250s | 2.64x | 2.74t | 37.40r-u | 38.14pqr |
| | $B_2$: Rate of 1.0 mg B 15 $L^{-1}$ as Milano | 2.32st | 2.34s | 0.261uv | 0.266pq | 2.82uv | 2.93r | 38.01p-s | 38.69nop |
| | $B_3$: Rate of 2.0 mg B 15 $L^{-1}$ as Milano | 2.36rs | 2.41r | 0.266tu | 0.273op | 2.86tu | 2.96qr | 38.14o-r | 39.23mno |
| | $B_4$: Rate of 0.5 g B 15 $L^{-1}$ as borax. | 2.27tu | 2.30s | 0.252w | 0.258r | 2.71w | 2.80st | 37.60q-t | 38.39opq |
| | $B_5$: Rate of 1.0 g B 15 $L^{-1}$ as borax. | 2.18v | 2.31s | 0.257vw | 0.264qr | 2.77vw | 2.86s | 37.76q-t | 38.61nop |
| | $B_6$: Rate of 0.5 g B 15 $L^{-1}$ as boric acid. | 2.39rs | 2.44r | 0.272st | 0.276o | 2.91st | 3.02q | 38.43n-q | 39.24mno |
| | $B_7$: Rate of 1.0 g B 15 $L^{-1}$ as boric acid. | 2.43qr | 2.53q | 0.277s | 0.284n | 2.97s | 3.11p | 38.52n-q | 39.38lmn |
| $T_5$: 100 % compost | $B_1$: Control (without B) | 1.84B | 1.90x | 0.195C | 0.199x | 2.14C | 2.24y | 35.28y | 36.34t |
| | $B_2$: Rate of 1.0 mg B 15 $L^{-1}$ as Milano | 2.01yz | 2.03v | 0.218A | 0.222v | 2.38A | 2.48w | 36.34vwx | 37.06st |
| | $B_3$: Rate of 2.0 mg B 15 $L^{-1}$ as Milano | 2.06xy | 2.14u | 0.225z | 0.233u | 2.45z | 2.54vw | 36.61u-x | 37.38rs |
| | $B_4$: Rate of 0.5 g B 15 $L^{-1}$ as borax. | 1.91AB | 1.95wx | 0.204B | 0.208w | 2.26B | 2.35x | 35.75xy | 36.25t |
| | $B_5$: Rate of 1.0 g B 15 $L^{-1}$ as borax. | 1.97zA | 1.99vw | 0.209B | 0.215vw | 2.33A | 2.41x | 35.97wxy | 36.75st |
| | $B_6$: Rate of 0.5 g B 15 $L^{-1}$ as boric acid. | 2.10wx | 2.14u | 0.230yz | 0.233u | 2.51z | 2.60uv | 36.88t-w | 37.64qrs |
| | $B_7$: Rate of 1.0 g B 15 $L^{-1}$ as boric acid. | 2.15vw | 2.24t | 0.236y | 0.242t | 2.58y | 2.66u | 37.15s-v | 38.13pqr |
| LSD at 5% | | 0.07 | 0.05 | 0.007 | 0.007 | 0.06 | 0.07 | 0.94 | 0.92 |

**$T_1$:100% ofNRD;$T_2$: 75% of NRD as mineral fertilizer + 25% of NRD as compost;$T_3$: 50% of NRD as mineral fertilizer + 50% of NRD as compost;$T_4$: 25% of NRD as mineral fertilizer + 75% of NRD as compost;$T_5$: 100% of NRD as compost;$B_1$: Control (without boron);$B_2$: Boron at rate of 1.0 mg B 15 $L^{-1}$ water using Milano [15 %boron];$B_3$: Boron at rate of 2.0 mg B 15 $L^{-1}$ water using Milano [15 %boron];$B_4$: Boron at rate of 0.5 g B 15 $L^{-1}$ water using borax [11%boron];$B_5$: Boron at rate of 1.0 g B 15 $L^{-1}$ water using borax [11%boron];$B_6$: Boron at rate of 0.5 g B 15 $L^{-1}$ water using boric acid [17%boron];$B_7$: Boron at rate of 1.0 g B 15 $L^{-1}$ water using boric acid [17%boron].**

Therefore, it can be said that a combination between mineral nitrogen in form of urea and compost as a source of N under foliar application of B may be suppressed environmental hazards of synthetics fertilizers and simultaneously is beneficial for sugar beet plants. The same trend was found for both studied seasons. These obtained results are in agreement with those of Mekdad, (2015) and Maharjan and Hergert, (2019).

**2.Plant performance at a maturity stage (180 days after planting).**

Data in Tables 5,6,7 and 8 show the influence of combined between mineral nitrogen as urea and compost at different ratios with foliar applications of different boron sources at different rates on physical root traits expressed in root diameter and length (cm), root fresh and dry weights(g $plant^{-1}$), root yield (ton $fed^{-1}$) (Tables 5 and 7), top fresh weights (g $plant^{-1}$ & ton $fed^{-1}$) and top dry weight (g $plant^{-1}$) (Tables 6 and 8) of sugar beet at a maturity stage (180 days after planting) during growing seasons of 2019/20 and 2020/21. All above mentioned characteristics could be considered as the main factors influencing production and performance of sugar beet.

**Individual effect:**

Different combinations between both mineral nitrogen as urea and compost showed significantly effect at physical root traits *i.e.,* root diameter and length (cm), root fresh and dry weights (g $plant^{-1}$), root yield (ton $fed^{-1}$) (Table 5 ), top fresh weight (g $plant^{-1}$ ), top dry weight (g $plant^{-1}$) and top fresh yield (ton $fed^{-1}$), (Table 6), where the highest values of all aforementioned traits were realized when sugar beet plants received 100 % of NRD as mineral nitrogen as urea followed by that of plants received 75% of NRD as mineral nitrogen in form of urea urea +25 % compost then the values of plants received 50% of NRD as urea +50 % compost then the values of plants received 25% of NRD as urea +75 % compost, while the lowest values were recorded with plants received 100 % of NRD as compost. Generally, it can be noticed that the performance of plant due to studied treatments at harvest stage looked just like performance of plant at period of 90 days and this proved that the effect of studied treatments on chemical constituents of leaves at 90 days after sowing positively reflected on physical traits and yield of root and top yield at harvest stage.

The differences among all studied treatments were discussed above. The same trend was found in both seasons. The results are in harmony with those of Hlisnikovský *et al.*, (2021).

Regarding to the boron treatments, the data in previous tables showed that spraying B at rate of 1.0 g 15 $L^{-1}$ as boric acid recorded the first ranking compared with other B treatments, where the best boron source was boric acid, while the commercial product named Milano came in the second rank followed by borax. Also, the values of all aforementioned traits increased as the B rate increased. The positive role of boron in this stage may be attributed to its role in sugar translocation and root elongation of plants (El-Sherpiny, 2016). These findings closely agree with those of Ibrahim *et al*., (2020). The same trend was found in both seasons.

**Table 5. Individual effect of different combination ratios between mineral nitrogen as urea and compost as well as foliar application of different boron sources at different rates on root yield and its physical characteristics of sugar beet plants at a period of 180 days after sowing during growing seasons of 2019/20 and 2020/21.**

| Treatments | Root diameter, cm | | Root length, cm | | Root fresh weight, g | | Root dry weight, g | | Root yield, ton $fed^{-1}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Nitrogen fertilization ratios (mineral + compost) | | | | | | | | | | |
| $T_1$ | 15.48a | 15.85a | 39.77a | 40.64a | 1415.86a | 1442.86a | 368.57a | 375.43a | 29.67a | 30.23a |
| $T_2$ | 14.43b | 14.75b | 38.26b | 39.02b | 1333.76b | 1358.90b | 346.14b | 353.48b | 27.95b | 28.52b |
| $T_3$ | 13.07c | 13.33c | 36.19c | 37.04c | 1187.29c | 1208.76c | 309.29c | 314.76c | 24.88c | 25.37c |
| $T_4$ | 11.33d | 11.59d | 33.88d | 34.64d | 1045.52d | 1064.29d | 277.43d | 282.43d | 21.91d | 22.30d |
| $T_5$ | 9.51e | 9.74e | 31.76e | 32.45e | 930.71e | 947.57e | 245.86e | 250.52e | 19.50e | 19.85e |
| LSD at 5% | 0.04 | 0.05 | 0.17 | 0.19 | 7.07 | 6.77 | 1.84 | 1.13 | 0.15 | 0.18 |
| Foliar application | | | | | | | | | | |
| $B_1$ (control) | 11.91g | 12.19g | 34.83f | 35.61e | 1109.27g | 1130.13g | 290.27g | 296.67f | 23.24g | 23.68g |
| $B_2$ | 12.83d | 13.10d | 36.01cd | 36.72c | 1186.67d | 1208.40d | 311.00d | 317.13c | 24.86d | 25.32d |
| $B_3$ | 12.99c | 13.26c | 36.29bc | 37.11b | 1204.27c | 1225.00c | 314.27c | 320.13c | 25.23c | 25.67c |
| $B_4$ | 12.40f | 12.67f | 35.55e | 36.26d | 1149.40f | 1167.47f | 301.67f | 306.87e | 24.08f | 24.53f |
| $B_5$ | 12.62e | 12.93e | 35.81de | 36.57cd | 1167.33e | 1190.53e | 306.47e | 312.00d | 24.46e | 24.95e |
| $B_6$ | 13.22b | 13.50b | 36.49ab | 37.37ab | 1222.13b | 1245.87b | 319.20b | 325.13b | 25.61b | 26.17b |
| $B_7$ | 13.37a | 13.70a | 36.83a | 37.66a | 1239.33a | 1263.93a | 323.33a | 329.33a | 25.97a | 26.48a |
| LSD at 5% | 0.13 | 0.13 | 0.36 | 0.37 | 11.90 | 12.25 | 3.20 | 3.21 | 0.25 | 0.28 |

**See footnote of Table 4.**

**Table 6. Individual effect of different combination between mineral nitrogen as urea and compost as well as foliar application of different boron sources at different rates on top fresh and dry weights of sugar beet plants at a period of 180 days after sowing during growing seasons of 2019/20 and 2020/21.**

| Treatments | Top fresh weight, g | | Top dry weight, g | | Top fresh yield, ton $fed^{-1}$ | |
|---|---|---|---|---|---|---|
| | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Nitrogen fertilization ratios (mineral + compost) | | | | | | |
| $T_1$ | 376.90a | 384.48a | 87.18a | 88.95a | 7.90a | 8.06a |
| $T_2$ | 351.48b | 358.00b | 82.45b | 83.90b | 7.36b | 7.50b |
| $T_3$ | 314.81c | 319.19c | 75.68c | 77.43c | 6.57c | 6.69c |
| $T_4$ | 278.33d | 283.38d | 69.70d | 70.64d | 5.83d | 5.94d |
| $T_5$ | 236.33e | 240.67e | 63.10e | 65.39e | 4.95e | 5.04e |
| LSD at 5% | 3.10 | 2.9 | 0.31 | 0.23 | 0.04 | 0.05 |
| Foliar application | | | | | | |
| $B_1$ (control) | 290.93g | 296.73g | 71.91g | 75.81f | 6.10g | 6.22g |
| $B_2$ | 313.00d | 318.93d | 75.80d | 76.70d | 6.56d | 6.68d |
| $B_3$ | 317.07c | 323.40c | 76.70c | 77.90c | 6.64c | 6.78c |
| $B_4$ | 303.13f | 308.67f | 73.97f | 76.46d | 6.35f | 6.47f |
| $B_5$ | 309.53e | 313.13e | 74.91e | 76.13e | 6.44e | 6.56e |
| $B_6$ | 321.00b | 326.53b | 77.55b | 78.22b | 6.72b | 6.84b |
| $B_7$ | 326.33a | 332.60a | 78.53a | 79.62a | 6.84a | 6.97a |
| LSD at 5% | 3.18 | 3.11 | 0.79 | 0.29 | 0.06 | 0.07 |

**See footnote of Table 4**

**Interaction effect:**

Data in Tables 7 and 8 illustrate that plants fertilized by 100% of NRD as urea and simultaneously sprayed with B at rate of 1.0 g 15 $L^{-1}$ as boric acid had the highest values of root diameter and length (cm), root fresh and dry weights (g $plant^{-1}$), root yield (ton $fed^{-1}$) (Table 7), top fresh weights (g $plant^{-1}$ & ton $fed^{-1}$) and top dry weight (g $plant^{-1}$) (Table 8) compared with other combination treatments. On the other hand, the plants received 75 % of NRD as urea plus 25% of NRD as compost and simultaneously sprayed with B from any studied source at any rate possessed values of all aforementioned traits higher than plants received 100 % of NRD as urea without B application. Therefore, these results confirmed possibility of using compost as a partial substitute for mineral nitrogen fertilizer (in form of urea). Our results are in harmony with those of El-Mantawy *et al.* (2021) who adopted that the use of compost as a partial substitute for mineral fertilizers leads to producing a good maize yield.

**Table 7. Interaction effect among studied treatments on root yield and its physical characteristics of sugar beet plants at 180 days after sowing in both seasons 2019/20 and 2020/21.**

| Treatments | | Root diameter, cm | | Root length, cm | | Root fresh weight, g | | Root dry weight, g | | Root yield, ton fed$^{-1}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $T_1$ | $B_1$ (control) | 14.00hi | 14.40hi | 37.67ghi | 38.37ghi | 1284.33k | 1307.67i | 332.00jk | 340.33j | 26.91k | 27.40kl |
| | $B_2$ | 15.70bc | 16.10bc | 40.00ab | 40.80abc | 1430.00cd | 1453.33cd | 372.67cd | 380.67bc | 29.96cd | 30.45cd |
| | $B_3$ | 15.80ab | 16.17b | 40.27ab | 41.13ab | 1444.00bc | 1468.67bc | 375.67bc | 383.00ab | 30.26bc | 30.77bc |
| | $B_4$ | 15.30d | 15.67d | 39.57bc | 40.50bc | 1399.67ef | 1426.33de | 366.33de | 371.67de | 29.32ef | 29.89def |
| | $B_5$ | 15.50cd | 15.83cd | 40.00ab | 40.77abc | 1414.00de | 1445.67cd | 367.67d | 374.67cd | 29.63de | 30.29cde |
| | $B_6$ | 15.97ab | 16.27ab | 40.33ab | 41.53a | 1459.00ab | 1489.67ab | 380.67ab | 388.00ab | 30.57ab | 31.21ab |
| | $B_7$ | 16.07a | 16.50a | 40.57a | 41.37a | 1480.00a | 1508.67a | 385.00a | 389.67a | 31.02a | 31.61a |
| $T_2$ | $B_1$ (control) | 13.80i | 14.10ij | 37.43hij | 38.20g-j | 1275.67kl | 1296.33ij | 328.67kl | 337.00j | 26.73kl | 27.16lm |
| | $B_2$ | 14.37g | 14.70gh | 38.27efg | 38.97efg | 1332.67hi | 1359.67gh | 348.33gh | 355.00gh | 27.92hi | 28.49hi |
| | $B_3$ | 14.70f | 14.97fg | 38.53def | 39.23def | 1355.00gh | 1378.33fg | 351.33g | 359.67fg | 28.39ef | 28.88gh |
| | $B_4$ | 14.10gh | 14.40hi | 37.80f-i | 38.50fgh | 1294.00jk | 1310.67i | 336.67ij | 343.67ij | 27.11jk | 27.79jk |
| | $B_5$ | 14.20gh | 14.60h | 37.97e-h | 38.79efg | 1313.67ij | 1345.67h | 343.33hi | 350.33hi | 27.52ij | 28.21ij |
| | $B_6$ | 14.87ef | 15.17ef | 38.73de | 39.43de | 1374.67fg | 1403.67ef | 354.67fg | 361.67fg | 28.80fg | 29.41fg |
| | $B_7$ | 15.00e | 15.30e | 39.10cd | 40.00cd | 1390.67ef | 1418.00e | 360.00ef | 367.00ef | 29.14ef | 29.71ef |
| $T_3$ | $B_1$ (control) | 12.50n | 12.70n | 35.27no | 36.10no | 1122.00rs | 1144.33op | 297.00q | 302.67op | 23.51rs | 23.97pq |
| | $B_2$ | 13.10l | 13.30m | 36.17lm | 36.97klm | 1190.67op | 1208.67mn | 309.00o | 314.00m | 24.95op | 25.33no |
| | $B_3$ | 13.20kl | 13.40lm | 36.47klm | 37.40jkl | 1209.67no | 1230.67lm | 312.67no | 317.33lm | 25.35no | 25.78n |
| | $B_4$ | 12.80m | 13.10m | 35.70mn | 36.40mn | 1143.00qr | 1159.00o | 300.67pq | 304.67no | 23.95qr | 24.28p |
| | $B_5$ | 13.00lm | 13.30m | 36.03lmn | 36.83lmn | 1166.67pq | 1188.67n | 306.00op | 312.00mn | 24.45pq | 24.91o |
| | $B_6$ | 13.40jk | 13.70kl | 36.67jkl | 37.67ijk | 1229.00mn | 1254.00kl | 317.67mn | 323.67kl | 25.75mn | 26.61m |
| | $B_7$ | 13.50j | 13.80jk | 37.03ijk | 37.90hij | 1250.00lm | 1276.00jk | 322.00lm | 329.00k | 26.19lm | 26.74m |
| $T_4$ | $B_1$ (control) | 10.47s | 10.67s | 32.97stu | 33.67tuv | 991.00yz | 1011.00u | 263.67vw | 268.67uv | 20.76yz | 21.18uv |
| | $B_2$ | 11.40p | 11.60pq | 33.90qr | 34.60qrs | 1047.67vw | 1069.00s | 278.00t | 284.00rs | 21.95vw | 22.40t |
| | $B_3$ | 11.57p | 11.87p | 34.07pqr | 34.97pqr | 1064.33uv | 1080.33rs | 281.00st | 285.00rs | 22.30uv | 22.63st |
| | $B_4$ | 10.80r | 11.00r | 33.40rst | 34.10stu | 1008.33xy | 1025.33tu | 269.00uv | 274.33tu | 21.13xy | 21.48uv |
| | $B_5$ | 11.10q | 11.40q | 33.60rs | 34.40rst | 1025.00wx | 1039.00t | 274.33tu | 278.00st | 21.48wx | 21.77u |
| | $B_6$ | 11.90o | 12.20o | 34.47pq | 35.27pq | 1085.67tu | 1106.67qr | 286.33rs | 291.33qr | 22.75tu | 23.19rs |
| | $B_7$ | 12.10o | 12.40no | 34.77op | 35.47op | 1096.67st | 1118.67pq | 289.67r | 295.67pq | 22.98st | 23.44qr |
| $T_5$ | $B_1$ (control) | 8.80x | 9.10x | 30.80z | 31.70z | 873.33F | 891.33z | 230.00B | 234.67B | 18.30F | 18.68A |
| | $B_2$ | 9.60v | 9.80uv | 31.70wxy | 32.27xyz | 932.33CD | 951.33wx | 247.00yz | 252.00yz | 19.54CD | 19.94xy |
| | $B_3$ | 9.70uv | 9.90tu | 32.10vwx | 32.80wxy | 948.33BC | 967.00w | 250.67xy | 255.67xy | 19.87BC | 20.26x |
| | $B_4$ | 9.00x | 9.20wx | 31.30yz | 31.80z | 902.00E | 916.00yz | 235.67AB | 240.00AB | 18.90E | 19.19zA |
| | $B_5$ | 9.30w | 9.50vw | 31.47xyz | 32.07yz | 917.33DE | 933.67xy | 241.00zA | 245.00zA | 19.22DE | 19.56yz |
| | $B_6$ | 9.97tu | 10.17t | 32.27uvw | 32.93vwx | 962.33AB | 975.33vw | 256.67wx | 261.00wx | 20.16AB | 20.44wx |
| | $B_7$ | 10.20st | 10.50s | 32.67tuv | 33.57uvw | 979.33zA | 998.33uv | 260.00w | 265.33vw | 20.52zA | 20.92vw |
| LSD at 5% | | 0.30 | 0.31 | 0.79 | 0.82 | 26.71 | 27.39 | 7.14 | 7.42 | 0.56 | 0.62 |

**Table 8. Interaction effect among studied treatments on top fresh and dry weights of sugar beet plants at a period of 180 days from sowing during growing seasons of 2019/20 and 2020/21.**

| Treatments | | Top fresh weight, g | | Top dry weight, g | | Top fresh yield, ton fed$^{-1}$ | |
|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| $T_1$ | $B_1$ (control) | 338.33jk | 345.33jk | 79.97jk | 81.73i | 7.09ij | 7.23ij |
| | $B_2$ | 381.67bc | 389.67cd | 87.99bc | 90.62c | 8.00bc | 8.17bc |
| | $B_3$ | 384.67b | 393.00bc | 88.80b | 90.57c | 8.06b | 8.23b |
| | $B_4$ | 373.33d | 380.67e | 85.92de | 87.74d | 7.82d | 7.98d |
| | $B_5$ | 376.67cd | 385.00de | 87.02cd | 88.34d | 7.89cd | 8.07cd |
| | $B_6$ | 388.67ab | 396.67ab | 89.74ab | 91.35b | 8.14ab | 8.31ab |
| | $B_7$ | 395.00a | 401.00a | 90.84a | 92.27a | 8.28a | 8.40a |
| $T_2$ | $B_1$ (control) | 333.67kl | 339.67kl | 79.24jk | 80.45j | 6.99jk | 7.12jk |
| | $B_2$ | 353.33gh | 358.33gh | 82.54ghi | 84.03g | 7.40fg | 7.51fg |
| | $B_3$ | 357.67fg | 365.00fg | 83.45fgh | 85.09f | 7.50ef | 7.65ef |
| | $B_4$ | 342.67ij | 350.33ij | 80.92ij | 82.03i | 7.18hi | 7.34hi |
| | $B_5$ | 347.33hi | 353.33hi | 81.74hi | 83.33h | 7.28gh | 7.40gh |
| | $B_6$ | 360.67ef | 367.67f | 84.17efg | 86.19e | 7.56e | 7.70e |
| | $B_7$ | 365.00e | 371.67f | 85.10ef | 86.20e | 7.65e | 7.79e |
| $T_3$ | $B_1$ (control) | 299.00pq | 305.00qr | 73.15opq | 74.55p | 6.26qr | 6.39pq |
| | $B_2$ | 314.00o | 319.67no | 75.65mn | 77.45m | 6.58no | 6.70mn |
| | $B_3$ | 318.67no | 325.00mn | 76.53mn | 78.32l | 6.68mn | 6.81lm |
| | $B_4$ | 302.67p | 307.67pq | 73.87op | 75.58o | 6.34pq | 6.45op |
| | $B_5$ | 317.67no | 313.00op | 74.80no | 76.63n | 6.45po | 6.56no |
| | $B_6$ | 322.67mn | 327.67m | 77.38lm | 79.23k | 6.76lm | 6.87l |
| | $B_7$ | 329.00lm | 336.33l | 78.42kl | 80.23j | 6.89kl | 7.05k |
| $T_4$ | $B_1$ (control) | 263.67w | 268.67x | 67.06uv | 68.60w | 5.52x | 5.63w |
| | $B_2$ | 278.00tu | 284.00uv | 69.66st | 70.30uv | 5.82uv | 5.95tu |
| | $B_3$ | 283.67st | 288.33tu | 70.66rs | 71.15st | 5.94tu | 6.04st |
| | $B_4$ | 269.00vw | 273.67wx | 68.01tu | 71.51s | 5.64wx | 5.73vw |
| | $B_5$ | 273.00uv | 277.33vw | 68.77tu | 69.70v | 5.72vw | 5.81uv |
| | $B_6$ | 288.33rs | 292.67st | 71.43qr | 70.59tu | 6.04st | 6.13rs |
| | $B_7$ | 292.67qr | 299.00rs | 72.30pqr | 72.62r | 6.13rs | 6.26qr |
| $T_5$ | $B_1$ (control) | 220.00B | 225.00y | 60.15B | 73.71q | 4.61C | 4.71B |
| | $B_2$ | 238.00yz | 243.00zA | 63.19yz | 61.08B | 4.99zA | 5.09yz |
| | $B_3$ | 240.67y | 245.67z | 64.05xy | 64.35z | 5.04z | 5.15y |
| | $B_4$ | 228.00A | 231.00BC | 61.11AB | 65.43y | 4.78B | 4.84AB |
| | $B_5$ | 233.00zA | 237.00AB | 62.21zA | 62.63A | 4.88AB | 4.97zA |
| | $B_6$ | 244.67xy | 248.00z | 65.03wx | 63.72z | 5.13yz | 5.20y |
| | $B_7$ | 250.00x | 255.00y | 66.00vw | 66.78x | 5.24y | 5.34x |
| LSD at 5% | | 7.12 | 6.95 | 1.76 | 0.65 | 0.15 | 0.15 |

## CONCLUSION

From the results and under the conditions of this study it could be concluded that combination between mineral and organic fertilizers as a source of N under foliar application of B may be suppressed environmental hazards of synthetics fertilizers and simultaneously is beneficial for sugar beet plants.

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## امكانية استخدام سماد المكمورة كبديل جزئي للسماد النيتروجيني المعدني وتقييم ذلك على اداء نباتات بنجر السكر المعاملة رشا بمصادر بورون مختلفة.


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أقيمت تجربتان حقليتان خلال موسمي 2020/2019 و2021/2020 بهدف تقييم إمكانية استخدام سماد المكمورة كبديل جزئي للأسمدة النيتروجينية المعدنية مع نباتات بنجر السكر المعاملة رشا بمصادر بورون مختلفة. استخدم التصميم الاحصائى القطع المنشقة فى تصميم التجربة فى الموسمين حيث وزعت مصادر التسميد النيتروجيني المختلفة فى القطع الرئيسية كما يلي ، 100٪ من جرعة النيتروجين الموصي بها (NRD) كسماد معدني ، 75٪ من NRD كسماد معدني بالإضافة إلى 25٪ من NRD مصدرها سماد المكمورة ، 50٪ من NRD كسماد معدني بالإضافة إلى 50٪ من NRD مصدرها سماد المكمورة ، 25٪ من NRD كسماد معدني بالإضافة إلى 75٪ من NRD مصدرها سماد المكمورة و 100٪ من NRD مصدرها سماد المكمورة بينما القطع المنشقة تضمنت معدلات ومصادر مختلفة من البورون كما يلي ، كنترول (بدون بورون) ، 1.0و 2.0 مجم بورون/ 15 لتر مصدرها ميلانو (15٪ بورون) ، 0.5 و 1.0 جم بورون/ 15 لتر مصدرها البوراكس (11٪ بورون) ، 0.5 و 1.0 جم بورون/ 15 لتر مصدرها حمض البوريك (17٪ بورون) كإضافة ورقية. قد أظهرت النتائج أن اضافة 100٪ من NRD كسماد معدني كانت المعاملة الأفضل مقارنة بغيرها من معاملات التسميد النيتروجيني الأخرى. وكذلك رش البورون بمعدل 1.0 جم بورون/ 15 لتر مصدرها حمض البوريك جاء في المرتبة الأولى مقارنة بمعاملات البورون الأخرى. على الجانب الاخر وجد ان النباتات المعاملة ب 75٪ من NRD كسماد معدني بالإضافة إلى 25٪ من NRD مصدرها سماد المكمورة وتم رشها في نفس الوقت باي مصدر بورون تم دراسته تحت أي معدل اظهرت أداء أفضل من النباتات المقابلة التي حصلت على 100٪ من NRD كسماد معدني بدون تطبيق البورون. لذلك تحت ظروف هذه الدراسة نستطيع ان نوصى بانه بتسميد البنجر ب75% من جرعة التسميد المعدني الموصي بها مع التعويض ب25% من سماد الكومبوست مع رش نباتات البنجر بأي مصدر من مصادر البورون للحصول علي اعلي إنتاجية من وحدة المساحة.