# EFFECT OF DUST METALS AND COMPOST ON GROWTH OF *Gundelia tournefortii* L. AND CHEMICAL COMPOSTION OF IT'S EDIBLE PORTION


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## ABSTRACT

**A field experiment was conducted at the Grdarasha Research Field station, College of Agricultural Engineering Sciences, Salahaddin University – Erbil using randomized complete block design (RCBD) during the years 2019-2021 to study the effect of five levels 0, 5, 10, 15 and 20 g of dust metals of Erbil steel factory (size 2mm mesh) in combination with compost of solid waste management and sorting of Akre district-Duhok province on growth, yield and chemical composition of *Gundelia tournefortii* L. The results indicated that powdery metal dust and compost fertilizer significantly increased length, diameter, fresh weight and dry weight of edible portion, and thus escalated the total yield of this plant for the two growing seasons. The highest value (669.07g/m$^2$) of total yield was recorded by application 20g of dust metals combined with compost fertilizer in the second year. Chemical composition of edible portion also affected by fertilizer application Fe%, Co, Ni, Cu, Zn, Se, Hg and Pb ppm. The results reviewed that the addition of mineral dust as nutrients and compost fertilizer significantly enhanced the concentration of these above elements in edible portion. The maximum response was obtained with the high levels of mineral treatments for all studied elements as compared with control.**



**Keywords: edible portion, chemical composition, compost solid waste fertilizer.**


***Part of Ph.D. Dissertation of the 1st author**



# تأثير غبار المعادن والكومبوست في نمو العكوب الجبلي .*Gundelia tournefortii* L والتركيب الكيميائي للجزء الذي يؤكل منه


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## المستخلص

أجريت هذه التجربة في محطة أبحاث حقل كرده ره شه، التابعة لكلية علوم الهندسة الزراعية، جامعة صلاح الدين–أربيل بأستخدام تصميم القطاعات العشوائية الكاملة خلال الموسمين الزراعين من 2019–2021 لدراسه تأثير خمسة مستويات 0, 5, 10, 15 و 20غم من غبار المعادن قطر 2ملم لمعمل الحديد في محافظة اربيل بالتداخل مع سماد الكومبوست المنتج من النفايات الصلبة المفروزة في منطقة أكري في محافظة دهوك في النمو والحاصل و التركيب الكيميائي لنبات العكوب الجبلي .*Gundelia tournefortii* L . أشارت النتائج الى ان غبار المعادن وسماد الكومبوست سبب زيادة معنوية في الارتفاع, القطر, الوزن الرطب و الوزن الجاف للجزء الصالح للأكل للنبات وبالتالي سبب زيادة الحاصل الكلي لموسمي النمو, وان أعلى قيمة 669.07غم م$^{-2}$ للانتاج تم تسجيلها للمعاملة 20غم لغبار المعادن المخلوطة مع سماد الكومبوست في الموسم الثاني للنمو. وقد أظهرت النتائج أن التركيب الكيميائي للجزء الصالح للأكل تأثر بأضافة السماد مثل الحديد والكوبلت والنيكل والنحاس والزنك والسلينيوم والزئبق والرصاص. وقد أكدت النتائج أن اضافة غبار المعادن كعناصر غذائية مع سماد الكومبوست زادت معنويا معها العناصر في الجزء الصالح للأكل, وأعلى أستجابة تم الحصول عليها مع أعلى مستوى من المعاملات لجميع العناصر المدروسة مقارنة مع النباتات غير المعاملة.



الكلمات المفتاحية: الجزء الصالح للاكل, المكونات الكيميائية, معمل اربيل للحديد, كومبوست سماد النفايات الصلبة.


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## INTRODUCTION

*Gundelia tournefortii* L. is a perennial plant belonging to the Asteraceae family (25). The underground portion is edible and marketable fresh yield commonly used by people as a vegetative cooking dishes with price 2$ per kg. The dry seeds locally named (Ce Ce) using as a nut with price 10-15$ per kg (6). Micronutrients (minor and trace elements) like Fe, B, Cu, Mn, Mo, Si, Zn, Ni, Cl, Se, Na, Al and Co which are essential for plant growth and development, perform many physiological functions, including structural composition, metabolism, enzymatic regulatory and ionic activity or/ and composition (29). The dust steel factory consists of many elements such as Fe, Cu, Mn, Ni, Cr, Zn, As, Pb, Co, Cd, Ti, V, Se, Sb, and Hg (12, 24). In agriculture, organic waste compost plays a major role in recycling vital plant nutrients preserving soil health and protecting the ecosystem from harmful hazard. However, this organic waste has an important positive effect on physical, chemical and biological properties of soil and promotes plant growth and thus increase crop yield production (16). Compost is regarding an economic and environmental friendly, means minimizing land fill waste, and also compost application can improve soil quality and productivity as well as crop production sustainability by replenishing soil organic matter and by providing nutrients (10). Grzegorzewski *et al.* (15) found that NPK+Mg and micronutrients B, Cu, Zn and Mn application significantly increased the root yield of sugar beet plant (*Beta vulgaris* L.). While, no significant effects were observed on the content of phosphor, potassium and calcium in sugar beet leaves and roots. Al-Khafaji et al (3) observed an increase in yield and antioxidant capacity of beets when they mixed vermicompost (30 ton.ha$^{-1}$) with the soil. On the other hand, Pongener *et al*. (21) found the positive impact of different micronutrients (B, Zn and Cu) on growth and root quality of carrot plant (*Daucus carota* L.). Salih (24) who studied the effect of dust metals on (*Eucalyptus amygdalina*) in dry and wet season. She indicated that dust steel company has clear effect on chlorophyll a, chlorophyll b, total chlorophyll and some chemical composition, such as Fe, Cu, Ni, Mn, Zn, As, Pb, and Co in plant leaves of Eucalyptus grown in the garden of Erbil steel factory. A study performed by Ghaly and Alkoaik (14) to determine the effect of municipal solid waste (MSW) compost and NPK fertilization on growth and production of three types of crops (potatoes, corn and squash). The results revealed that the good plant growth and yield for potatoes and corn were given with application MSW compost, while NPK fertilizer have been produced the maximum plant growth and yield of squash when compared with control. Zerga and Tsegaye (34) studied the impact of various rates of compost application (0, 25, 50, and 75ton ha$^{-1}$) on growth and yield parameters of (*Daucus carota* L.) carrot plant. The results showed that the compost application in the rate 75ton ha$^{-1}$ given the highest value of growth characteristics and yield components. Also, on the same plant Wafaa, (30) observed that organic fertilizer like (chicken manure, cattle manure and compost) with four rates of sulfur was significantly enhanced the uptake of micronutrients Fe, Cu, Mn and Zn by carrot plant. The aim of this study to show the possible effects of different types of fertilizer on growth, yield and some chemical composition in *Gundelia tournefortii* L. edible portion by applied minerals or metals of micronutrients or trace elements in powdery of dust steel factory and compost (Waste recycling compost), however to indicate the different between organic and chemical fertilizer.

## MATERIALS AND METHODS

This experiment conducted at Grdarasha Research Field station, College of Agricultural Engineering Sciences, Salahaddin University – Erbil, for two years during 2019-2020 and 2020-2021 to study the effect of dust metals and compost fertilization on growth and development of *Gundelia tournetortii* L. Figure (1). Grdarasha Research Field is locating at 36. 20° N, 44.10° E and at an elevation 470m above sea level. Representative air – dried, soil samples were taken for Grdarasha field at the depth (0-30cm), then sieved with 2mm mesh and analyzed for some physical and chemical properties as shown in Table (1).

**Table 1. Some chemical and physical properties of the field soil of Grdarasha**

| Soil properties | Grdarasha Field | Soil properties | Grdarasha Field |
|---|---|---|---|
| Sand % | 12.5 | Chromium (Cr) ppm | 70 |
| Slit % | 42.5 | Manganese (Mn) ppm | 290 |
| Clay % | 45 | Cobalt (Co) ppm | 12 |
| Texture Class | Silty clay | Copper (Cu) ppm | 34 |
| pH | 8.02 | Zinc (Zn) ppm | 49 |
| Electrical conductivity (EC) $Ms.cm^{-1}$ | 135.8 | Cadmium (Cd) ppm | 0.1 |
| Organic matter (O.M) mg/ml | 4.52 | Vanadium (V) ppm | 86 |
| Nitrogen (N) ppm | 23.2 | Nickel (Ni) ppm | 141 |
| Phosphor (P) ppm | 28 | Lead (Pb) ppm | 1.04 |
| Potassium (K) ppm | 107 | Iron (Fe) % | 3.3 |

Five levels of dust metals of Erbil steel factory with treatment (T) and minerals addition treatments $T_1$=0, $T_2$=5g, $T_3$=10g, $T_4$=15g and $T_5$=20g (23) and every level of dust metals mixed with compost fertilizer (household organic waste that sieved with 2mm mesh) $T_6$ =0+compost, $T_7$ = 5g+compost, $T_8$ =10+compost, $T_9$ =15+compost and $T_{10}$ =20+compost at the rate $3kgm^{-2}$ (22) before sowing of seeds in plots with dimensions (1m × 1m) area and 15cm distance between rows and plants with three replications. Dust metals was obtained from (ERBIL STEEL COMPANY) and compost fertilizer from (MRF Group – Akre Recycling Sorting Company - Duhok). After collection of the dust, the dust powder was preserved in the room temperature for determination the heavy metals and representative air – dried compost sample, then sieved with 2mm mesh. The powder dust and compost samples were analyzed by using XRF (X-ray fluorescence spectrophotometer) Sky Instrument Genius, using Handheld thermal scientific Genius 9000 XRF (11). Nitrogen, phosphorus, potassium and organic matter analyzed by using Soil nutrient analyzer instrument. Some chemical and physical properties of Dust steel factory and compost as shown in Tables 2 and 3. *Gundelia tournefortii* L. seeds were obtained from the Barzan factory – Erbil. The seeds were sown on November 1st, 2019 at depth of 6-7cm directly (5). Through the experimental period plants were watered as necessary with sprinkler irrigation and manual weed control repeated more than once.

**Experimental parameters**

**1-**Length (cm) of edible portion was measured by ruler and diameter (mm) by using Vernier.

**2-**Fresh weight of edible portion (g) edible portion were weighted after removes roots soil residue and all leaves by sensitive electronic balance.

**3-**Dry weight of edible portion (g) was measured after oven dried to constant weight at 75c° for 72hours, when the color of edible portion turned to yellow color then, weighted by sensitive electronic balance.

**4-**Total yield ($gm^{-2}$) was calculated from the weighted marketable and non-marketable edible portion ($gm^{-2}$) for all plants in the experimental unit.

**5-** For determination the heavy metals (Fe, Cu, Mn, Zn, Ni, Cr, As, Pb, Co, V and Cd) concentration in edible portion, edible portion samples have been oven-dried at 75°C for 72 hours, crashed, homogenized and sieved. The powdered samples were analyzed by XRF (X-ray fluorescence spectrophotometer) Sky Instrument Genius, using Handheld thermal scientific Genius 9000 XRF (11). The statistical analysis was carried out by using SPSS (Statistical Package for Social Sciences) Program, version (22.0) in 2015. Comparisons between means were made using Duncan's Multiple Range Test at 5% level for all germination parameters (13, 31).

## RESULTS AND DISCUSSION

### 1. Edible portion characteristics

According to the results presented in Table (4) the length of edible portion (cm) significantly increased by treatments. The highest value (6.27cm) was scored in $T_9$ in the 2020, while for $T_5$ and $T_9$ (7.85 and 7.86 cm) in the 2021. In both growing seasons the lowest value was recorded in $T_1$. In the other hand, T10 gave the greater rate of diameter of edible portion of *Gundelia tournefortii* L. plant (7.34 and 17.07 mm) and minimum value was obtained in $T_1$ for two years of trial. These results partially agreed with BL Lanna *et al*. (7) for Radish plant and Pongener *et al*. (21) for Carrot plant.

Table (4) clarified the influence of dust metal of Erbil steel factory and compost fertilization on fresh and dry weight of *Gundelia tournefortii* L. for the two studying year. $T_9$ and $T_{10}$ produce the greater fresh weight of edible portion in the first year of growth (1.68 and 1.95 g) and $T_{10}$ (15.05g) in the second year. $T_1$ occupy the lowest position of fresh weight of edible portion (0.67 and 8.03g) for both seasons. The maximum amount of dry weight of edible portion of this plant was received from $T_{10}$ in the 2020 and $T_5$ in 2021. While, the minimum value of this character was recorded by $T_1$ in both growing seasons. It is obviously clear from figures 2 and 3 total yield $gm^{-2}$ of *Gundelia tournefortii* L. gradually increased from $T_1$ to $T_{10}$ and $T_{10}$ occupy the highest position in both growing seasons. These results partially achieve with those obtained by BL Lanna *et al*. (7) concerning Radish plant, Sarkar *et al.* (26) concerning Potato plant, Pongener *et al*. (21), Zerga and Tesgaye (34) concerning Carrot plant Al-Dulaimi and Al-Jumaili (1) concerning Green Been plant and AL-Juthery and Saadoum (2) concerning Jerusalem Artichoke. Dalzell *et al.* (9) stated that yield advantages have been found with combined application of mineral fertilizer and compost in many crops and its possible to argue that these results can be explained mainly by difference in the quantities of nutrients suppled, as the organic fraction will always contain trace elements not found in the mineral fertilization. Organic fertilizer is needful for plant because, the low quantities of organic matter leads to limit production (7). It is obvious that substantial and beneficial nutrient elements contribute to crop quality via functioning such as the materials in synthesis of different plant components that have nutritional value for human and animals (18). The elements in dust steel factory and compost fertilizer have many physiological effect on plant growth and development such as: Iron (Fe): the reduction or oxidation conditions in the soil by Fe and it is plays a role in a structural component, enzyme activation and synthesis of chlorophyll (32) and (23). The activity of some enzymes that play a good role in carbohydrates metabolism, chloroplast and cytoplasm by Zn (19). Electron transporting proteins in photosynthesis, respiratory chain and creating functional ethylene receptors (27). Antioxidant functions in the plant by Se (28). Ureolysis, methane biogenesis, actitogenes and hydrogen metabolism in addition to that maintaining the cellular redox state, stress tolerance and optimum nitrogen use efficiency by Ni (33). A catalyst in several enzymatic and physiological reactions in plants involved photosystem II, plant's respiratory process, activates enzyme concerned with the metabolism of nitrogen and synthesis of chlorophyll by Mn (29). And regulated the different metabolic pathway, photosynthesis and seed germination by Co (17).

**Table 2. The concentration of heavy metals in the Erbil dust steel factory**

| Heavy metals | Concentration (mg/kg) | Heavy metals (mg/kg) | Concentration (mg/kg) |
|---|---|---|---|
| Iron (Fe) | 1080.28 | Cobalt (Co) ppm | 107.82 |
| Copper (Cu) | 1873.74 | Cadmium (Cd) | 3.05 |
| Manganese (Mn) | 6436.62 | Thallium (Ti) | 6991.80 |
| Nickel (Ni) | 835.31 | Vanadium (V) | 181.75 |
| Chromium (Cr) | 699.27 | Selenium (Se) | 4.98 |
| Zinc (Zn) | 607132.07 | Antimony (Sb) | 0.99 |
| Arsenic (As) | 4538.06 | Mercury (Hg) | 0.015 |
| Lead (Pb) ppm | 11432.05 | | |

**Table 3. Some chemical and physical properties of compost fertilizer.**

| Properties | Compost fertilizer composition | Properties | Compost fertilizer composition |
|---|---|---|---|
| Electrical conductivity (EC) $Ms.cm^{-1}$ | 7.3 | Cobalt (Co) ppm | 9 |
| pH | 7.48 | Copper (Cu) ppm | 533 |
| Organic matter (O.M) mg/ml | 17.01 | Zinc (Zn) ppm | 136 |
| Nitrogen (N) ppm | 40 | Cadmium (Cd) ppm | 0.2 |
| Phosphor (P) ppm | 24 | Vanadium (V) ppm | 0.0 |
| Potassium (K) ppm | 80 | Nickel (Ni) ppm | 118 |
| Chromium (Cr) ppm | 43 | Lead (Pb) ppm | 121 |
| Manganese (Mn) ppm | 33 | Iron (Fe) % | 2.9 |

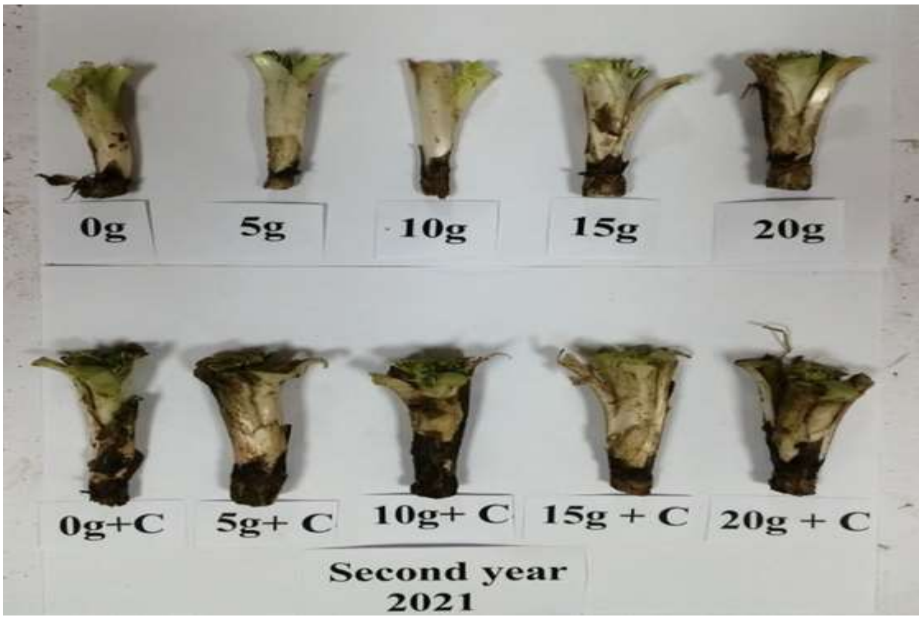


**Figure 1. The effect of some dust metals and compost fertilization on the growth of *Gundelia tournefortii* L. edible portion in the second year**

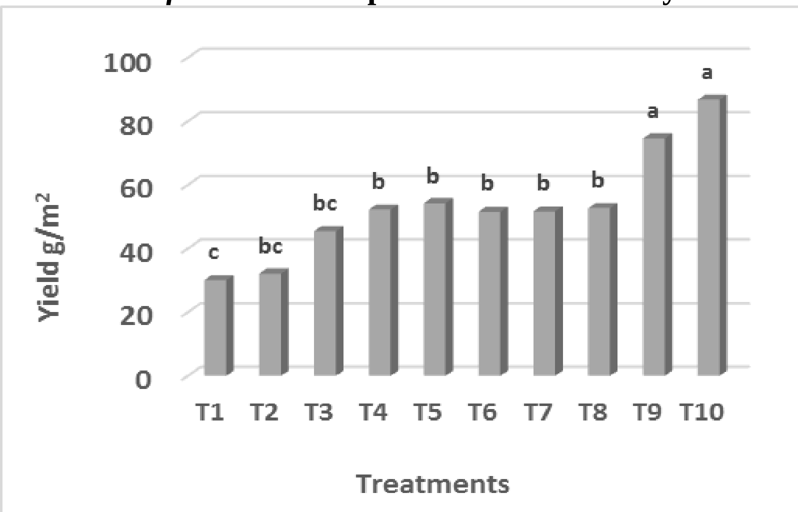


**Figure 2. Effect of different levels of dust metals and compost fertilizer on total yield g/m$^2$ in the first year of sowing**

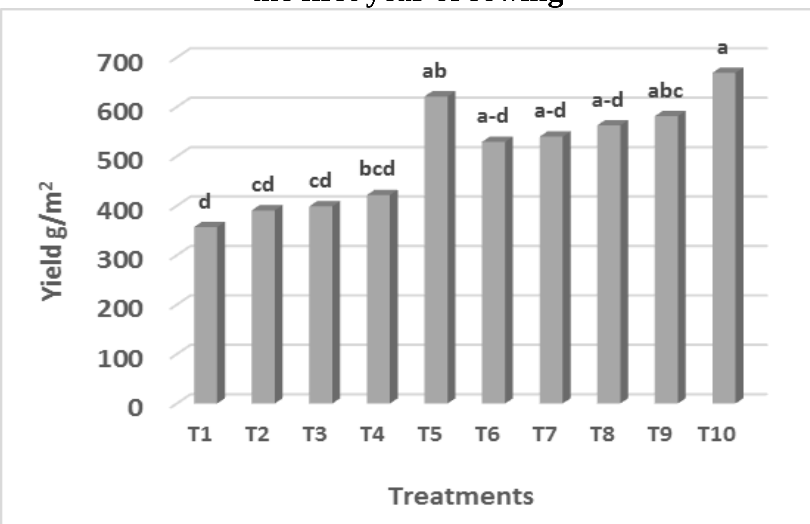


**Figure 3. Effect of different levels of dust metals and compost fertilizer on total yield g/m$^2$ in the second year of sowing**

***The similar letters between treatments means there are no significant differences between them using Duncan's Multiple Test at 5% level**

**Table 4. The effect of different levels of dust metals and compost fertilizer on some edible portion characteristic for the two studying seasons (2019-2020 and 2020-2021)**

| Treatments | Length of edible portion (cm) | | Diameter of edible portion (mm) | | Fresh weight of edible portion (g) | | Dry weight of edible portion (g) | |
|---|---|---|---|---|---|---|---|---|
| | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 |
| $T_1$ | 4.88 c ±0.29 | 6.41 c ±0.21 | 4.15 c ±0.44 | 13.30 b ±0.81 | 0.67 c ±0.01 | 8.03 d ±0.75 | 0.13 d ±0.01 | 0.71 abc ±0.00 |
| $T_2$ | 5.06 c ±0.15 | 6.96 abc ±0.20 | 4.32 c ±0.18 | 13.63 ab ±0.86 | 0.72 bc ±0.07 | 8.79 cd ±0.38 | 0.14 d ±0.01 | 0.62 c ±0.04 |
| $T_3$ | 5.65 abc ±0.24 | 7.31 abc ±0.43 | 5.82 b ±0.32 | 13.63 ab ±0.65 | 1.02 bc ±0.16 | 8.97 cd ±0.60 | 0.18 cd ±0.01 | 0.70 abc ±0.03 |
| $T_4$ | 5.28 bc ±0.33 | 7.72 ab ±0.38 | 6.38 ab ±0.43 | 15.01 ab ±0.86 | 1.17 b ±0.19 | 9.49 bcd ±0.45 | 0.21 bc ±0.02 | 0.66 bc ±0.09 |
| $T_5$ | 5.20 bc ±0.17 | 7.85 a ±0.35 | 6.45 ab ±0.84 | 16.70 ab ±1.16 | 1.22 b ±0.14 | 13.97 ab ±1.33 | 0.23 bc ±0.03 | 0.99 a ±0.12 |
| $T_6$ | 5.37 bc ±0.43 | 6.58 bc ±0.50 | 5.75 b ±0.57 | 15.30 ab ±0.45 | 1.16 b ±0.02 | 11.91 a-d ±1.64 | 0.21 bc ±0.02 | 0.78 abc ±0.09 |
| $T_7$ | 5.72 abc ±0.17 | 7.08 abc ±0.17 | 6.10 bc ±0.55 | 15.71 ab ±0.94 | 1.16 b ±0.15 | 12.14 a-d ±0.65 | 0.21 bc ±0.02 | 0.21 bc ±0.02 |
| $T_8$ | 5.67 abc ±0.18 | 7.69 ab ±0.45 | 6.22 ab ±0.25 | 15.78 ab ±1.13 | 1.18 b ±0.16 | 12.66 a-d ±1.72 | 0.25 abc ±0.00 | 0.97 ab ±0.00 |
| $T_9$ | 6.27 a ±0.41 | 7.86 a ±0.44 | 6.19 ab ±0.31 | 16.04 ab ±1.06 | 1.68 a ±0.16 | 13.08 abc ±1.74 | 0.26 ab ±0.01 | 0.90 abc ±0.08 |
| $T_{10}$ | 6.01 ab ±0.19 | 7.02 abc ±0.28 | 7.34 a ±0.17 | 17.07 a ±1.81 | 1.95 a ±0.16 | 15.05 a ±2.38 | 0.31 a ±0.00 | 0.93 abc ±0.09 |

***The similar letters between treatments means there are no significant differences between them using Duncan's Multiple Test at 5% level**

**2. Chemical composition of edible portion**

Table (5) shows the concentration of some chemical composition in edible portion of *Gundelia tournefortii* L. in the first season of study. $T_{10}$ scored the highest value of Fe% and Cu, Zn, Se ppm (1.37%, 53.33ppm, 45.61ppm and 1.90ppm) respectively, the rate of Co significantly progress with increasing the dust steel factory and the maximum values were recorded for $T_3$, $T_4$ and $T_5$. While, only $T_5$ gave the greater amount of Ni (74.46ppm). Hg concentration in edible portion significantly increased with combined the two treatments dust steel factory and compost and the $T_9$ and $T_{10}$ (0.23 and 0.24ppm) respectively occupy the greater level of this element. With increasing the level of the treatments rise the concentration of Pb ppm in edible portion. Regarding the micronutrients content in the second year of trial resulted in Table (6). Chemical composition influences by addition of dust steel factory and compost fertilizer and $T_{10}$ become superior in the elements (Fe, Cu, Zn, Co, Ni and Pb) in edible portion. While, Se gave the highest rate (4.77ppm) by $T_4$ but, $T_9$ escalated the amount of Hg (0.39ppm). From the obtained results it is appear that the effect of organic fertilizer (compost) and micronutrients (dust metals) as important materials for improving the uptake of some elements in edible portion of *Gundelia tournefortii* L. these results partially similar to those achieved by Wafaa (30) concerning carrot plant, Grzegorzewski *et al.* (15) concerning sugar beet plant and Sarker *et al.* (26) concerning potato plant. A positive balance between nutrients lead to accumulation or increasing the metal concentration in soil and the progresses of these elements in edible portion content might be to the high concentrations of these elements in the both fertilizer (dust steel factory and compost) depending on the analysis of these types of fertilizer (Table 2 and 3). According to Grzegorzewski *et al.* (15) this order of element concentration in the edible portion might be a consequence of the growth stage, which influences the content of virtually all macro-and micronutrients. Municipal solid waste compost promoted the yield production and increasing the bioavailability of some trace elements like (Cu, Zn, Fe, Mn, Cr. Ni, Pb and Cd) in the soil (20). Also Chatterjee *et al.* (8) in their research about effect of organic wastes on soil health and crop growth mentioned that organic waste for plant nutrient supply is become more important for replenishment or act of resupplying for plant nutrients. The uptake of mineral nutrients across the root and translocation of nutrients, water and photosynthetic with in the plant are governed by physical parameters such as, diffusion and water potential, as well as, involving implicitly biological processes like, active transport (32). And there are significant correlations between solubility of trace elements such as, Cu, Hg and Cd and soil organic matter (4)

**Table 5. The effect of different levels of dust metals factory and compost fertilizer on some chemical composition in edible portion in the first year 2019-2020**

| Treatments | Fe % | Co(ppm) | Ni(ppm) | Cu(ppm) | Zn(ppm) | Se(ppm) | Hg(ppm) | Pb(ppm |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | 0.65 f ±0.01 | 2.65 f ±0.03 | 38.83 h ±0.05 | 39.52 h ±0.00 | 23.47 j ±0.03 | 1.02 i ±0.00 | 0.01 d ±0.00 | 2.87 e ±0.05 |
| $T_2$ | 1.08 cd ±0.02 | 3.75 b ±0.05 | 52.66 d ±0.01 | 41.71 g ±0.00 | 28.24 h ±0.02 | 1.09 h ±0.00 | 0.07 c ±0.00 | 3.13 d ±0.00 |
| $T_3$ | 1.10 cd ±0.21 | 3.93 a ±0.04 | 55.95 b ±0.00 | 41.68 g ±0.00 | 35.75 e ±0.01 | 1.15 g ±0.00 | 0.07 c ±0.00 | 3.36 b ±0.00 |
| $T_4$ | 1.18 bc ±0.02 | 3.94 a ±0.02 | 55.57 c ±0.01 | 41.71 g ±0.00 | 34.51 f ±0.01 | 1.16 g ±0.00 | 0.08 c ±0.00 | 3.75 a ±0.00 |
| $T_5$ | 1.36 ab ±0.04 | 3.99 a ±0.00 | 74.46 a ±0.00 | 44.78 f ±0.00 | 36.57 d ±0.00 | 1.68 d ±0.00 | 0.07 c ±0.00 | 3.72 a ±0.00 |
| $T_6$ | 0.78 e ±0.00 | 3.11 e ±0.01 | 45.68 g ±0.00 | 45.32 e ±0.00 | 27.61 i ±0.00 | 1.33 f ±0.00 | 0.08 c ±0.00 | 2.08 f ±0.00 |
| $T_7$ | 1.05 d ±0.03 | 3.22 d ±0.01 | 47.54 f ±0.00 | 50.88 d ±0.00 | 33.25 g ±0.02 | 1.46 e ±0.00 | 0.18 b ±0.00 | 3.27 c ±0.00 |
| $T_8$ | 1.12 b-d ±0.08 | 3.27 d ±0.00 | 49.81 e ±0.01 | 51.07 c ±0.03 | 42.88 c ±0.01 | 1.84 b ±0.00 | 0.18 b ±0.00 | 3.33 bc ±0.00 |
| $T_9$ | 1.24 ab ±0.05 | 3.48 c ±0.00 | 49.87 e ±0.00 | 52.22 ab ±0.05 | 44.76 b ±0.00 | 1.81 c ±0.00 | 0.23 a ±0.01 | 3.77 a ±0.01 |
| $T_{10}$ | 1.36 a ±0.03 | 3.45 c ±0.00 | 49.86 e ±0.03 | 53.33 a ±0.03 | 45.61 a ±0.00 | 1.90 a ±0.00 | 0.24 a ±0.00 | 3.74 a ±0.00 |

***The similar letters between treatments means there are no significant differences between them using Duncan's Multiple Test at 5% level.**

**Table 6. The effect of different levels of dust metals and compost fertilizer on some chemical composition in edible portion in the second year 2020-2021**

| Treatments | Fe % | Co(ppm) | Ni(ppm) | Cu(ppm) | Zn(ppm) | Se(ppm) | Hg(ppm) | Pb(ppm |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | 0.28 f ±0.00 | 1.87 h ±0.00 | 1.77 i ±0.00 | 50.49 j ±0.00 | 50.97 i ±0.03 | 0.09 j ±0.00 | 0.09 g ±0.00 | 2.49 h ±0.00 |
| $T_2$ | 0.29 ef ±0.00 | 1.98 f ±0.00 | 2.67 h ±0.02 | 51.03 i ±0.00 | 56.88 f ±0.00 | 0.19 i ±0.00 | 0.09 g ±0.00 | 3.14 f ±0.00 |
| $T_3$ | 0.37 c ±0.00 | 2.05 d ±0.00 | 7.79 f ±0.00 | 56.68 f ±0.00 | 64.37 e ±0.26 | 0.98 f ±0.00 | 0.12 f ±0.00 | 3.19 e ±0.00 |
| $T_4$ | 0.38 bc ±0.00 | 2.12 c ±0.00 | 11.42 c ±0.00 | 57.02 e ±0.00 | 64.84 d ±0.00 | 1.01 e ±0.00 | 0.18 e ±0.00 | 3.45 b ±0.00 |
| $T_5$ | 0.39 b ±0.00 | 2.18 b ±0.02 | 11.70 b ±0.05 | 57.78 d ±0.00 | 65.60 c ±0.00 | 4.77 a ±0.00 | 0.19 e ±0.00 | 3.43 c ±0.00 |
| $T_6$ | 0.29 ef ±0.00 | 1.95 f ±0.01 | 4.54 g ±0.05 | 52.79 h ±0.00 | 41.61 j ±0.00 | 0.09 j ±0.00 | 0.23 d ±0.00 | 2.30 i ±0.00 |
| $T_7$ | 0.30 de ±0.00 | 1.98 f ±0.00 | 7.78 f ±0.01 | 52.83 g ±0.00 | 51.43 h ±0.00 | 0.89 h ±0.00 | 0.32 c ±0.00 | 2.73 g ±0.00 |
| $T_8$ | 0.31 d ±0.00 | 1.91 g ±0.00 | 9.34 e ±0.00 | 59.15 c ±0.00 | 52.86 g ±0.00 | 1.23 d ±0.00 | 0.32 bc ±0.00 | 3.22 d ±0.00 |
| $T_9$ | 0.32 d ±0.00 | 2.02 e ±0.00 | 11.17 d ±0.00 | 71 04 b ±0.00 | 66.71 b ±0.00 | 1.46 c ±0.00 | 0.39 a ±0.00 | 3.46 b ±0.00 |
| $T_{10}$ | 0.41 a ±0.00 | 2.23 a ±0.00 | 17.31 a ±0.00 | 72.86 a ±0.00 | 99.03 a ±0.00 | 3.47 b ±0.00 | 0.34 b ±0.00 | 3.77 a ±0.00 |

***The similar letters between treatments means there are no significant differences between them using Duncan's Multiple Test at 5% level.**

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