Effect of compaction and fertilizers on the growth and development of *Zea mays L.*

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Abstract— **Soil compaction has become an important issue for soil sustainability. Municipal solid waste (MSW) compost is an 'organic' amendment and can act like inorganic fertilizers and subsequent plant growth in compacted conditions. The aim of this experiment is to study the impact of further cured MSW compost and inorganic fertilizers (N and P) on *Zea mays* L. under two levels of soil densities. Compaction was done manually. A random experiment design distribution was used with six treatments; the plant's morphological and physiological characteristics were studied. After 120 days of growth period, fresh samples were collected and plant's morpho-physiological characteristics were studied and data was submitted to statistical analysis using SPSS 17. Compaction had unexpected effect on the control where no fertilizer is added, and the treatments with N fertilizers in non-compacted soil were higher than the other inorganic fertilizers. Further cured compost alleviates the adverse effects of compaction and recorded the highest values indicating that mature MSW compost can replace the inorganic fertilizers, then, lowering the cost of fertilization and a solution for the difficulties of soil acidity and the growing production of municipal solid wastes**

Index Terms— Compaction, Compost curing, inorganic fertilizers, MSW compost, Zea mays L..

I. INTRODUCTION

The Green Revolution started in the 1950s to meet the boosting population needs for food and to improve the quality, diversity and resistance of crops. It depended on the use of fertilizers, pesticides, machines and irrigation to produce the most important crops such as wheat, corn and rice that provide 50% of the global caloric intake. On the other hand, the miracle that gave higher crop production and as such improved agriculture started to cause serious public health and environmental problems.

Public awareness has increased regarding the possible effects of agricultural mechanical operations on human-induced soil degradation. Among the effects of these agricultural operations are both surface and subsoil compaction. The growing size of agricultural heavy machinery and increasing time pressure on farmers to complete mechanical operations have more increased the severity of compaction as a major problem in modern agriculture. Placing organic or inorganic fertilizers in a compacted soil may allow the limited root system to draw adequate nutrients because of higher nutrient concentration in a smaller volume of soil. Chemical fertilizers use is for the purpose of increasing the agriculture product as well they increase the quality of plants. Yet the excess application of fertilizers can cause soil to become more acidic, thereby reducing crop yield. On the other hand, good soil fertility can somewhat reduce the harmful effects of compaction by supplying adequate quantities of organic and inorganic fertilizers. In this study, the impact of compost as an organic fertilizer, that was brought from South Lebanon (Ain Baal) and treated at the Lebanese University in 2012, was tested as a soil amendment. The objectives of this experience were first, to study the effects of compaction on the maize and on morphological physiological properties, secondly to investigate the role of compost and chemical fertilizers in compacted soil and thirdly to check the efficiency the inorganic and the organic fertilizer for agricultural practices. The specific objectives of this study were to evaluate the application impact of MSW compost on the morphological and physiological characteristics of the corn crops in compacted soil conditions.

II. MATERIALS AND METHODS

A. *Soil Analysis*

The natural soil used in this study was brought form Ainata (South Lebanon) and collected at approximate 40 cm depth. Soil texture was determined using Bouyoucos Hydrometer Method. In order to determine the porosity, a specific volume of soil sample was tapped firmly to a cylinder. Then a volume of water was added to the same cylinder, the total volume was recorded, then the former volume was subtracted from the latter, which is the volume of the solid space. The solid space volume is subtracted from the tapped sample to get the volume of the pores. Lastly, the pore volume is divided by the tapped sample to get the porosity (%). pH and other physical and chemical characteristics such as total calcareous, electrical conductivity and organic matter were measured according to Kobaissi et al. (2013) (1).

B. *System Preparation*

Compaction was done manually in PVC columns (60 cm high cylindrical PVC tubes of 15.6 cm internal diameter) with two bulk density level of 1.25 $g.cm^{-3}$ and 1.45 $g.cm^{-3}$ (2), corresponding to medium and heavy compacted soil, respectively (3). The soil was mixed with mature or cured compost, provided by the Laboratory of Plant and Environment (4), at the percentage of 2.5% of the total soil volume before filling in pots. The inorganic fertilizers, N and P, were dissolved in the irrigated water by fertigation (5; 6) for 6 weeks from V4 to V6 growth stage of corn where this timing is efficient for achieving good quality characters and maximum biomass production of maize (7). Along with the control without compost or fertilizer' application, with three replicates each (Table 1).

The culture was done under controlled conditions in growth room between February and July 2013. During the period of the experiment with 12-hour photoperiod, 18/22°C day/night temperatures and 40/60% air moisture. By the end of the experiment, the plants were collected and several morphological parameters were measured.

Table 1: Different treatments and their abbreviations

Treatment	Abbreviations
Control non compacted soil	SD_1
Control compacted soil	SD_2
2.5% Cured non compacted soil	$C_{2.5\%}D_1$
2.5% Cured compacted soil	$C_{2.5\%}D_2$
N+P non compacted soil	NPD_1
N+P compacted soil	NPD_2
N non compacted soil	ND_1
N compacted soil	ND_2
P non compacted soil	PD_1
P compacted soil	PD_2

C. *Morphological Parameters*

After 120 days of growth, height of each plant was measured from soil level to the top meristem and the number of leaves was counted. Plants were subsequently harvested and separated into stems, leaves and roots where fresh weight was determined. The length of the roots was measured after washing them out of the soil with distilled water to remove adhering soil materials. After these characteristics measurements, leaves, stems and roots were dried at 80°C for at least two days to obtain the dry weight. Fresh leaves were scanned and leaf area was measured by mass/area relationship. Specific leaf area (SLA, cm^2/g), biomass fraction dedicated to leaves (LMR, Leaf Mass Ratio, g/g), stem (SMR, Stem Mass Ratio, g/g), roots (RMR, Root Mass Ratio g/g) were calculated as biomass ration of the fraction and total biomass. Also, root length ratio (RLR, cm/g) as a ratio of total root length and plant mass and specific root length (SRL, cm/g) as a ratio of total root length and root's biomass. Leaf area ratio (LAR, the total leaf area per unit of total plant dry mass, cm^2/g) was calculated as the product of SLA and the leaves proportion LMR, being LAR = SLA × LMR.

D. Physiological Parameters

At the harvest, fully expanded and exposed leaves at the same plant parts were randomly selected from each replication of each treatment to determine leaf composition. Measurements of nitrate reductase activity and chlorophyll content were done on the same leaves and same plants according to Saad *et al.* (2016) (8). Chlorophyll and carotenoids were extracted by incubation of leaves in acetone (80%) for 24 h. Measurements of optical density was done using a spectrophotometer (wave lengths of 663, 645 and 440 nm for chlorophyll a, b and carotenoids, respectively). The respective concentrations of chlorophyll a and b were calculated according to Arnon (1949). The potential NRA was estimated in fresh leaves by incubation in 0.1 M phosphate buffer (pH 7.5), 30 mM KNO_3, and 5% isopropanol at 28^{o}C for 2 h, followed by the addition of sulfanilamide 3 M HCl and 0.02% naphthylethylene diamine hydrochloride (NED HCl). The mixture was left for 20 min for maximum color development prior to optical density measurement with a spectrophotometer at 540 nm.

E. Statistical Analysis

Statistical analyses were performed using XLSTAT software (Addinsoft^{TM}). When necessary, data were log-transformed before analysis in order to improve normality and variance homogeneity of residues. Variance analyses were performed by a one-way ANOVA with fixed effect (type 1 F statistics). Post hoc tests were performed using the Duncan method at the 5 % level.

III. RESULTS

A. Soil Preliminary Tests

The soil used was analyzed in the Pedology lab at the Lebanese University. Results of the soil texture analysis showed that it was a clayey soil (Clay: 61.25%, Sand: 23.43% and Silt: 15.31%) and slightly alkaline (pH = 7.96), suitable for the corn growth. The porosity was tolerable (48.68%) for a heavy soil, it permits root growth and development. As expected, total calcareous was low (0.33%), due to the poor presence of stones and gravels. Electrical conductivity was (0.72 mS/cm), also adequate for corn growth. In addition, the soil had low organic matter (0.78%), as it resembles virgin soil with no cultivations and plant residues. Therefore the effects of the treatments (i.e. fertilizer addition) would be effective and significant on the plant development.

B. Outcomes of compaction and fertilizers on the aerial part

The compost used in this study originated from Ain Baal compost facility and it was cured according to Kobaissi et al. (2013) (4). The treated compost will be referred in the following as cured, while the initial sample will be referred as non-cured.

1) Consequences on the morpho-physiological characteristics of the leaves

Table 2 represents the effect of compaction and fertilizers on corn's leaf number. It shows that the non-compacted N-treated soil (ND1) had the highest leaf number with significant difference with respect to all treatments. The treatment NPD2 had the lowest leaf number which is significantly different from the N+P non-compacted soil, i.e. NPD1. Furthermore, there is a significant effect of compaction in case of the combination of N+P, NPD1 and NPD2, and in case of N fertilizer, ND1 and ND2. In addition, ND1 showed a significant increase of 20.83% in comparison with the control SD1. Also, there's no significant effect of compaction in case of the organic fertilizer 2.5% cured compost.

The leaf dry weight and the leaf area (Table 2) are linked by a strong positive correlation. An inverse effect of compaction was shown in case of the control, where the control compacted soil SD2 is significantly higher than SD1, which has the lowest values. However, the treatments with N fertilizers in compacted soil, ND2, are clearly affected. For this treatment, there was a significant reduction of 46.28%, 48.88% for the leaves dry weight and leaves area respectively, when compared with ND1.

Hence, no significant effect of compaction was found for the treatments with P fertilizers. However, the compacted treatments with the combination of N and P (NPD2) are negatively affected by compaction and significantly different from the non-compacted treatments NPD1. Yet, no significant effect of compaction was found in case of the organic fertilizer, 2.5% cured compost. Nevertheless, $C_{2.5\%}$D1 and $C_{2.5\%}$D2 had the highest values in the leaf dry weight and the leaf area, and were significantly different compared to other treatments.

Table 2: Effect of compaction and fertilizers on the leaves' characteristics

Treatments	Leaf Number		Leaf Dry Weight (g)		Leaf Area (cm^2)	
SD_2	11.33±0.47	ab	1.04±0.05	def	373.89±5.36	c
SD_1	12±0.0	bc	0.72±0.04	ab	248.43±36.51	a
ND_2	11.5±0.5	ab	0.79±0.14	abc	293.97±20.79	ab
ND_1	14.5±0.5	d	1.48±0.02	h	575.12±59.45	e
PD_2	12.33±0.47	bc	1.13±0.05	efg	556.9±45.13	e
PD_1	12.33±0.47	bc	1.29±0.17	gh	573.87±14.73	e
NPD_2	10.67±0.47	a	0.88±0.15	bcd	346.56±29.41	bc
NPD_1	12.33±0.47	bc	1.24±0.10	fg	456.69±11.22	d
$C_{2.5\%}D_2$	13±0.0	c	1.98±0.04	i	686.91±41.31	f
$C_{2.5\%}D_1$	12.33±0.47	bc	1.89±0.06	i	745.71±25.46	f

Note: Means within columns followed by the same letter do not differ significantly according to Duncan's multiple range test (α=0.05).

The total content of chlorophyll and the nitrate reductase activity in the leaves are shown in table 3. The results revealed the absence of significant difference between the control SD1 and SD2, the treatments with N fertilizers ND1 and ND2 and the treatments with P fertilizers PD1 and PD2. Also, no effect of compaction was observed between these treatments. In addition, the treatments with the combination of N and P, NPD1 and NPD2 revealed the lowest values with no significant effect of compaction. On the other hand, the treatments with the organic fertilizers, $C_{2.5\%}$D1 and $C_{2.5\%}$D2 had the highest chlorophyll content. The control SD2 had significantly the lowest nitrate reductase activity with respect to all treatments. SD2 was significantly affected by compaction in comparison with the control SD1. Furthermore, there was a significant compaction effect on treatments with inorganic fertilizers, specifically in the case of P fertilizer, with a reduction of 46.47% between PD1 and PD2. Whereas, an inverse effect of compaction was found for the treatments with organic fertilizer, with a significant increase of 21%. Also, there was no significant effect between ND1, PD1, NPD1 and $C_{2.5\%}$D2.

Table 3: Effect of compaction and fertilizers on NRA and chlorophyll content in the leaves

Treatments	Nitrate Reductase Activity (µmol $NO_2^-g^{-1}$ h^{-1})		Total Chlorophyll (µg mL^{-1})	
SD_2	113.7±34.29	a	7.38±0.44	abc
SD_1	151.2±23	b	9.27±0.62	cdef
ND_2	201.2±10	d	8.22±0.2	bcd
ND_1	268.5±17.7	efg	8.33±1.23	bcd
PD_2	161.2±13.08	bc	6.86±1.37	bc
PD_1	301.2±1.77	g	8.73±0.68	bcde
NPD_2	236.0±5.50	e	5.86±0.96	a
NPD_1	283.5±22.63	fg	7.06±0.69	ab
$C_{2.5\%}D_2$	285.2±5.90	fg	10.5±0.84	ef
$C_{2.5\%}D_1$	235.2±20.9	e	10.54±1.28	ef

Note: Means within columns followed by the same letter do not differ significantly according to Duncan's multiple range test (α=0.05).

2) Stem's parameters affected by compaction and use of fertilizers

The effects of compaction and the use of organic and inorganic fertilizers on the morphology of the stem are shown in table 4. The plant height indicated that the use of organic fertilizers, 2.5% cured compost, had significantly increased the height of the plant in comparison to all treatments. The treatments with inorganic fertilizers in non-compacted soil, ND1, PD1 and NPD1 had higher plant's height with respect to the control SD1 and SD2, and ND2, PD2 and NPD2. However, the height of the plant of ND1, PD1 and NPD1 was less than treatments with organic fertilizer, $C_{2.5\%}$D1 and $C_{2.5\%}$D2.

Positive and strong correlations were found between the stem length and the stem dry weight. There was no significant effect between the treatments with organic fertilizer, $C_{2.5\%}$D1 and $C_{2.5\%}$D2 except for the stem dry weight where a significant reduction of 18.34% existed under compaction. Moreover, $C_{2.5\%}$D1 and $C_{2.5\%}$D2 had the highest values, followed by the treatment with N fertilizer in non-compacted soil, ND1. In case of the treatment with P fertilizer, there was no significant effect of compaction for the stem length and the stem dry weight. Additionally, there was a significant effect of compaction for the treatments with N fertilizer and the combination N+P. Still, the control non-compacted SD1 has the lowest rate.

Table 4: Effects of compaction and fertilizers on plant height, stem's length and dry weight

Treatments	Plant Height (cm)		Stem Length (cm)		Stem Dry Weight (g)	
SD_2	79.17±1.35	bc	37±2.45	c	0.59±0.15	bcd
SD_1	76.53±2.65	ab	31.67±2.87	ab	0.32±0.06	ab
ND_2	77.15±2.33	ab	35.1±1.92	bc	0.4±0.13	abc
ND_1	91.45±1.55	e	58.9±0.90	e	1.76±0.08	f
PD_2	80.5±1.08	bc	43.67±2.72	d	0.91±0.09	de
PD_1	86.53±2.47	de	46.07±1.89	d	0.82±0.14	e
NPD_2	80±1.45	bc	31.75±0.61	ab	0.37±0.07	ab
NPD_1	86.75±2.88	de	48.2±1.88	d	0.68±0.04	cde
$C_{2.5\%}D_2$	100.97±2.96	f	65.6±3.2	f	1.97±0.18	f
$C_{2.5\%}D_1$	105.2±2.34	f	68.5±2.15	f	2.42±0.08	g

Note: Means within columns followed by the same letter do not differ significantly according to Duncan's multiple range test (α=0.05).

3) Higher bulk density and fertilizers effects on the root system

The effects of the use of organic and inorganic fertilizers under compaction on the morphology of the root system are shown in table 5. The control (SD2) had the lowest root length and the treatments with organic fertilizers, 2.5% cured compost, $C_{2.5\%}$D1 had the highest root length with significant difference in comparison to all other treatments. Also, no effect of compaction was found within the controls, the treatments with N fertilizer and with P fertilizer. However, a significant effect of higher bulk density was found within the treatments of the combination N+P fertilizers and 2.5% cured compost with a reduction of 27.67% and 16.28% respectively.

Concerning the root dry, treatment with N fertilizer in non-compacted soil ND1, had the highest root dry weight with a significant increase of 687.5% and 65.78%, if compared to the control (SD1), and $C_{2.5\%}$D1. The effect of compaction was evident for the treatments with N fertilizer, the combination of N+P fertilizers, and for the treatments with 2.5% cured compost. However, no effect of compaction was found with the controls and with P fertilizer.

Table 5: Variation of the root's length and dry weight with compaction and fertilizers

Treatments	Root Length (cm)		Root Dry Weight (g)	
SD_2	18.13±2.05	ab	0.06±0.00	b
SD_1	21.4±0.50	bc	0.05±0.02	ab
ND_2	25±2.04	cde	0.08±0.01	bc
ND_1	29.35±2.74	de	0.42±0.02	g
PD_2	24.8±1.99	cd	0.14±0.03	d
PD_1	28.87±2.10	def	0.12±0.00	d
NPD_2	21.3±1.14	bc	0.07±0.01	b
NPD_1	29.45±1.27	ef	0.11±0.01	cd
$C_{2.5\%}D_2$	32.9±2.96	f	0.21±0.01	e
$C_{2.5\%}D_1$	39.3±2.43	g	0.25±0.02	f

Note: Means within columns followed by the same letter do not differ significantly according to Duncan's multiple range test (α=0.05)

4) Plant Growth Performance influenced by Compaction and Use of Fertilizers

Leaf Mass Ratio (LMR), Stem Mass Ratio (SMR), Root Mass Ratio (RMR), Specific Leaf Area (SLA) and Leaf Area Ratio (LAR) are displayed in Figure 1. A strong negative correlation existed between LMR and SMR (r^2= -0.98). ND_1 had the highest RMR and SD_2 has the lowest one in comparison with all treatments. When LMR decreased, that is caused by an increase of the proportion of the stem's dry weight, and vice versa. As to SLA, the treatments with phosphate fertilizer had the highest values with significant difference with respect to all other treatments, which are all similar. As for LAR, a strong positive correlation linked this ratio with LMR (r^2= 0.75), and its variation is parallel to the proportion of the dry weight of the leaves. LAR showed an inverse impact of compaction and fertilizers, like LMR, so, the lowest values were for ND_1 and the treatments with organic fertilizers at the two densities.

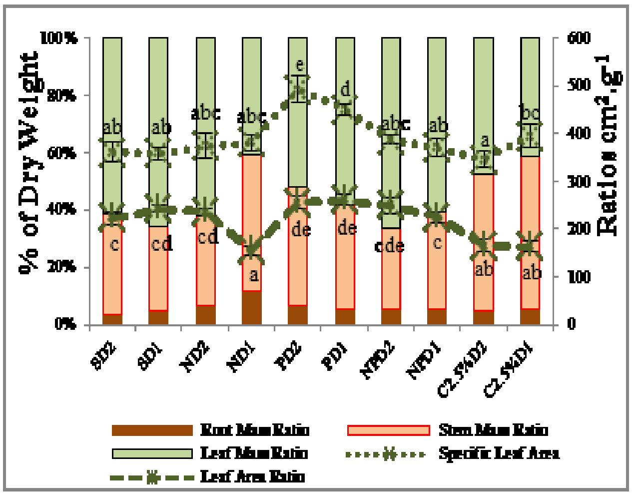

Figure 1: Plant's performance affected by compaction and fertilizers

Note: Means (points) with the same letter do not differ significantly according to Duncan's multiple range test (α=0.05)

Figure 2 shows the effect of compaction and fertilizers on the Specific Root Length (SRL, Fig. 2a) and the Root Length Ratio (RLR, Fig. 2b). A negative correlation linked RLR and the total dry weight, and SRL and the root dry weight (r^2= -0.84 and r^2= -0.74 respectively). In addition, RLR and SRL were strongly positively correlated (r^2= 0.78). For these two ratios, SD_1 had the highest values, and ND_1, $C_{2.5\%}D_1$ and $C_{2.5\%}D_2$ had the lowest RLR and SRL with significant difference with respect to all treatments, showing an inverse effect of fertilizers and compaction. In case of RLR, highest performance is for SD_1 and ND2, followed by NPD_2. Also, SD_2, PD_2 and PD_1 were not significantly different. Furthermore, in case of SRL, ND_2, PD_1, PD_2, NPD_1 and NPD_2 were significantly similar.

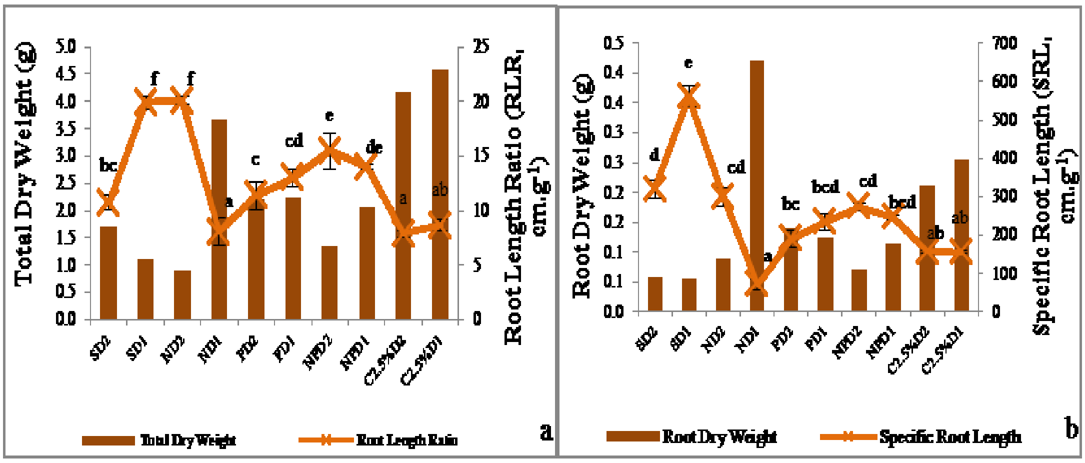

Figure 2: Effect of compaction and fertilizers on RLR (a) and SRL (b)

Note: Means (points) with the same letter do not differ significantly according to Duncan's multiple range test (α=0.05)

As a summary, an opposite effect of compaction was observed for the control, where SD2 had higher values than the non-compacted control (SD1), whereas the compaction's outcome was obvious for the treatments with N fertilizers and the combination of N+P fertilizers. However, and for approximately all the parameters, there was no effect of compaction on the treatments with P fertilizer. It is important to indicate that ND1 and the treatments with organic fertilizer ($C_{2.5\%}$D1 and $C_{2.5\%}$D2) had the best performance in almost all the studied parameters of the different plant's parts. At the same time, $C_{2.5\%}$D1 and $C_{2.5\%}$D2 had same records, showing that no effect of compaction on the plants with organic fertilizers. Different levels of correlations were present between the parameters of the leaves, stem and roots, which are all positively interrelated and affecting the plant growth. Ratios came to give an idea about the overall plant's performance, where some of them were positively correlated with the previous parameters, yet, others were inversely correlated.

IV. DISCUSSION

The results highlighted the positive outcome of organic compost on corn plant by improving their growth. Our results confirm previous work (9) where an improvement of corn growth under the application of MSW was showed. In our study, the application of 2.5% cured compost gave the highest values for all parameters studied. Plants cultivated with N fertilizers in non-compacted soils grew at the same rate of treatments with 2.5% cured compost. The effect of compaction was evident on treatments with N fertilizer, N+P fertilizers for the shoot and roots biomass. Root growth in compacted soils was restricted due to a maximum development in the soil top layer where roots were not able to expand deeper. As a result, shoots were harmfully affected (10). In the case of the control, where no fertilizer was added, an inverse effect of compaction was found and SD2 had higher values for the studied parameters than SD1. Compaction here had beneficial effects on the plant growth by which was related to increasing nutrient per volume unit and soil water absorption where its organic matter is very low (1). Compaction damages the leaves, stem and roots' parameters in the case of mineral fertilizers application (i.e. N fertilizers). Many studies had shown that compaction favored soil anoxic conditions (11) where soil organisms started to use nitrate instead of oxygen and denitrification occurs (10). In addition, certain anaerobic bacteria release hydrogen sulfide which is toxic to many plants (10). Same reasons are shown in the case of N+P fertilizers, where compaction was found altering severely all the plant's characteristics. Furthermore, treatments with N+P fertilizers in non-compacted soil were significantly similar to those with P fertilizer. This fact showed that there was no effect of N fertilizer in the combination of N+P and in compacted soil. In addition, no effect of P fertilizer was shown due to the dominance of denitrification process. Treatments with P fertilizer confronted the problem of compaction, where no significant effect was found between the compacted and non-compacted treatments. This was due to the higher root to soil contact allowing the restricted root system to draw more nutrients. Although, adding P and N+P fertilizers, increased the biomass production if compared to the controls. However, N fertilizer in non-compacted soil had highest records for the plant growth and the root length among the inorganic fertilizers. This was due to directed root growth in response to the spatial distribution of nitrates in the soil. Total chlorophyll did not offer a clear impact of compaction and fertilizers on the corn growth. However, it's important to notice that treatments with organic fertilizers had better values in comparison to other treatments. Nitrate reductase activity decreased with compaction for the control and chemical fertilizers treatments due the denitrification process and low uptake of N. An inverse effect of compaction was observed for organic treatment due to higher nitrates availability provided by cured compost in compacted soil. It is plain to assist that the use of organic fertilizers was the best choice for the corn cultivation in this study. Organic fertilizers have been reported to buffer soils and increase water retention capacity leading to enhanced germination and vigorous plant growth (12). Moreover, organic materials can act as slow nutrient releasers in the soil avoiding their leaching to underground water. Also, using of 2.5% cured compost points out an important clarification that for some parameters, results for non-compacted soil and for N fertilizer were similar. For other studied parameters, this rate of compost was found to have higher values with significant difference. This indicates that MSW compost can provide adequate and balanced supply of nutrients just like inorganic fertilizers (12). In addition, the use of organic fertilizers (i.e. MSW compost) proved the possibility to alleviate the detrimental effects of soil compaction and especially in clay soil.

Nevertheless, the obtained results indicated that organic compost further cured enhanced the plant development. In fact, the further decomposition of compost improves the availability of nutrients (4), which showed that the quality of compost has a major impact on morpho-physiological traits of plants (9).

CONCLUSION

The application of mature MSW compost improved the growth and development of corn. The use of cured compost at 2.5% level improved the corn development in comparison to the control and other fertilizers. Nitrogen fertilizers caused deleterious effects on the plant growth due to the denitrification process initiated by anoxic conditions in compacted soil. Phosphate fertilizers diminished the negative effects of compaction and it increased the plant growth when compared to the control. With the combination of N+P fertilizers, no effect of the P fertilizer was detected in compacted conditions, and that was caused by the harmful effect of the denitrification process. Yet, treatments with N+P fertilizers in non-compacted soil enhanced the growth when compared to the control. Further cured compost diminished the harmful effects of severe compaction on the *Zea mays* L. plants compared to the chemical fertilizers. And in non-compacted soil, cured compost' results were similar to those obtained with N fertilizer. May studies have shown that MSW compost addition to the soil surface has can ameliorate soil physical properties as the organic matter and carbon content, porosity, structural stability and water retention capacity. The use of MSW compost is thus a suitable alternative to chemical fertilizers for corn production due to its long term benefits for the soil. MSW compost ensures a safe and healthy environment by stabilizing soil organic matter which is a key factor for sustained agricultural productions. In our study, slow-release nitrogen fertilizer (i.e. MSW compost) application to corn plants caused an increase in plant height, biomass production, root development and leaf area. Therefore, MSW application can replace many types of organic and inorganic fertilizers and especially for clayey in order to restore their fertility. The production of MSW compost fertilizer by composting solid wastes could be also a possible solution for solid wastes problem in a countries facing this major problem as Lebanon. Future work will be correlated to this study through highlighting the effect of compaction and fertilizers on the soil microbial properties in the presence of *Zea mays* L.

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