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# DIRECT AND RESIDUAL EFFECTS OF MIXING THE ADDED COMPOST TO A CALCAREOUS SOIL WITH SULPHUR AND PHOSPHORUS:
# II- ON DRY MATTER OF TWO SUCCESSIVE CROPS AND THEIR NUTRIENT UPTAKE

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## ABSTRACT

A field experiment was conducted at the Agricultural Research Station Farm of Noubaria, during two successive growing seasons (2001-2002) on a calcareous sandy clay loam soil to study the direct effect of compost, sulphur and phosphorus on dry matter of faba bean seeds and straw, and some nutrient uptake by them as well as the residual effect on the same parameters of maize plant due to these applications. Two kinds of composts (A and B) each at a rate of 4 ton/fed were applied in addition to a control treatment, either individually or in combination with 200 kg S/fed and /or 13.5 kg P/fed. Treatments were incorporated in a split plot design with four replicates.

**The obtained results could be summarized in the followings:**

Calcareous soil manuring with any of the two used composts, either individually or in combination with S and P was of significant effect on increasing dry matter yield of faba bean plants and their uptake of N, P, Fe, Mn and Zn. The residual effects of the aforementioned treatments were pronounced on uptake of N, P and Mn by the successive grown plant, i.e., maize. Compost A was significantly superior to B in increasing dry matter yield of straw and whole faba bean plant, N and Fe uptake while the opposite was true in case of Mn and Zn uptake. There were no significant differences between compost A and B effects on P-uptake by different parts of both the studied crops.

Data revealed that application of compost A or B in combination with both S and P increased faba bean seed and straw dry matter weights over compost A or B combined with S or P treatments.

As a conclusion, it could be recommended that using compost at a rate of 4 ton/fed in combination with 200 kg S/fed and 13.5 kg P/fed is significantly beneficial to obtain the economically best results under such a soil as a direct effect, while addition of a portion of the studied materials (determined through further studies) may be more beneficial than their residual effects.

**Keywords:** Calcareous soil, Compost, Sulphur, Phosphorus, Faba bean, Maize.

## INTRODUCTION

Soil fertilization or manuring has an essential role for supplying plants with nutrients. This role can be effective for several months according to the nutrient release. Yields, yield components and chemical composition of plants are good parameters to estimate application efficiency. Therefore, rates of farmyard manure are significantly effective in increasing most of absorbed macro and micronutrients by different parts of plant (Negm *et al.*, 2002a)

The amounts of farmyard manures available to Egyptian farms are not only insufficient but also decreasing with the increasing tendency towards the mechanization of agriculture. An alternative way to meet the growing needs for organic manure is by composting plant and animal residues (Addel Ghaffar, 1978).

Many studies have been done to improve the beneficial effect of composted organic materials through additin of P fertilizer (Wassif *et al*; 1988 and Genaidy, 1994). Sarkadi (1995) reported that combined application of organic matter and superphosphate caused increasing P content in plants. El-Fayoumy (1996), Hashem *et al.*(1997), Awad *et al.*(2000) and Negm *et* al.(2001,2002b and 2002c) clarified the importance of mixing organic manures whatever their sources with sulphur or gypsum for improving calcareous soil properties and productivity of plants (wheat-sorghum-soybean and maize) due to increasing the efficiency of each other.

Negm *et al.* (2002d and 2003) concluded that Bicompsite application at a rate of 4 ton/fed in combination with 200 kg S/fed is significantly beneficial to obtain the economically best results under calcareous soils as a direct effect, while renewal or repeat addition of 4 ton/fed of Biocomposite may be more beneficial than its residual effect. Fazal and Sisodia (1989) reported that higher levels of P and S increased grain yields of wheat and maize. Lentil plant dry weight, N and P uptake increased with superphosphate and sulphur compared to control (Saber and Kabesh, 1990 and El-Raies *et al.*, 1997).

Therefore, the objective was to study the direct and residual effects of two kinds of compost, sulphur and phosphorus added to a calcareous soil on dry matter production and some nutrient uptake using faba bean as an indicator crop in the winter season and maize in following summer season.

## MATERIALS AND METHODS

A field experiment was conducted at the Experimental Farm of Noubaria Agriculture Research Station, Northern Tahrir, Beheira Governorate, Egypt during two successive seasons (2001 and 2002) on a sandy clay loam soil, the main soil characteristics are shown in Table (1). The obtained composts were a commercial one (comp.A) and a suggested one prepared by Soils, Water and Environment Research Institute, ARC, Giza, the chemical analysis of the composts are shown in Table (2). Analyses of soil and composts were determined according to the standard methods (Black, 1965 for soil and Brunner and Wasmer, 1978 for composts).

**Table (1): Some chemical and physical characteristics of the studied soil.**

| Soil Depth cm | pH 1:2.5 susp. | SP % | $EC_e$† dS/m | Soluble cations (meq/100g soil) † | | | | Soluble anions (meq/100g soil)+ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $CO_3^{=}$ | $HCO_3^{-}$ | $Cl^{-}$ | $SO_4^{=}$ |
| 0-20 | 8.00 | 48.00 | 2.60 | 0.42 | 0.43 | 0.58 | 0.03 | - | 0.19 | 0.49 | 0.78 |
| 20-40 | 8.08 | 48.60 | 2.52 | 0.36 | 0.39 | 0.55 | 0.03 | - | 0.21 | 0.38 | 0.74 |

| Soil depth cm | Total N % | Available nutrients (mg $kg^{-1}$) | | | | | OM % | $CaCO_3$ | Mechanical analysis (%)‡ | | | | Soil texture class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | P | K | Fe | Mn | Zn | | | Coarse sand | Fine sand | Silt | Clay | |
| 0-20 | 0.042 | 8.32 | 500 | 3.20 | 3.0 | 1.34 | 0.62 | 23.11 | 15.31 | 37.46 | 20.13 | 27.10 | SCL‡ |
| 20-40 | 0.037 | 7.70 | 447 | 2.75 | 2.8 | 2.80 | 0.57 | 25.21 | 13.95 | 37.52 | 23.80 | 24.73 | SCL |

† In saturation soil paste extract ‡SCL = Sandy clay loam.

**Table (2). Some main characteristics of the used composts.**

| Compost | Moisture % | pH 1:10 susp. | EC dS/m | OC % | Total N % | C/N ratio | Total | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | P % | K % | Fe % | Mn mg $kg^{-1}$ | Zn mg $kg^{-1}$ |
| A | 12.6 | 7.81 | 3.60 | 18.77 | 1.99 | 9.42 | 0.99 | 1.30 | 1.05 | 500 | 140 |
| B | 33.0 | 6.20 | 5.00 | 27.50 | 1.30 | 21.15 | 1.10 | 0.98 | 0.80 | 284 | 167 |

The experiment design was a split plot with four replicates in the both seasons. The main plots were assigned to composts (0, comp.A and comp.B each at 4 ton/fed rate) while sulphur (0, and 200 kg S/fed as elemental S) and phosphorus (0 and 13.5 kg P/fed as calcium superphosphate 6.7%P) were randomly assigned to the subplots. The area of each plot was (3.5 x 6 m). The composts were thoroughly mixed with the soil tillh layer one week before sowing faba bean (*Ficia faba* c.v.Noubaria 1) on the 7$^{th}$ of November 2001. After harvesting faba bean on the 26$^{th}$ of May 2002, the same plots were prepared for the following crop without any additions of either composts, sulphur or phosphorus. Grains of maize (*Zea mays* L c.v. Hybrid 310) were sown on the 3$^{rd}$ of June 2002. Basal application of mineral N, P and K fertilizers were added as mentioned by Rehan *et al*., (2004) in the 1$^{st}$ part of the current study.

Only the day just before each crop harvest, samples of 5 plants were collected, separated into seeds and straw in case of faba bean and grains and stover in case of maize and prepared for dry matter and nutrient determinations. After wet digestion of plant tissues according to Sommers and Nelson (1972), the macronutrient N, P and K were determined according to Chapman and Pratte (1961). The micronutrient Fe, Mn and Zn were determined using Atomic Absorption Spectrophotometry (Perkin Elmer 3300).

The statistical analyses of data were done according to the methods described for split-plot in randomized complete block design by Snedecor and Cochran (1971).

## RESULTS AND DISCUSSION

**Dry matter yield:**

Direct and residual effects of the studied treatments on dry matter yield of plant parts are shown in Table (3).

The dry matter of faba bean seeds, straw and whole plant increased significantly by application of any of the two used composts. However, compost A was significantly superior to another one (B) in case of straw and whole plant. Application of sulphur was significantly beneficial in increasing dry matter of seeds, straw and whole faba bean plant (summation of seeds and straw). On the other hand, phosphorus effect was found to be insignificant on faba bean dry matter. The interaction effect of these three factors, however, was significant. The most pronounced case was the significant increase in seed dry matter weight due to the treatment consisting of compost B combined with sulphur over that consisting of compost A with sulphur (33.68 vs. 31.04 g/plant). These results may be attributed to the composition of the applied compost itself, as well as the beneficial effect of sulphur and phosphorus. These results are in agreement with those obtained by Wassif *et al.*(1988), Awad *et al.*(2000), Negm *et al.*(2002b,c, d and 2003) who found that application of compost either alone or in combination with sulphur or phosphorus improved the growth and yield of the treated crops. This may be attributed to improvement in physical and chemical properties of soil, such as decreasing soil pH, and increasing both macro-, micronutrients availabilities in the soil, besides improving nutrient uptake and the elemental status in plant.

The dry matter yield of maize grain, stover and the whole plant were not affected significantly by the residual effect of any of these additions individually. The double interaction of these factors was significantly effective in increasing grain dry matter yield as mentioned below. Application of compost A without S was significantly superior to unmanured treatment, that treated with compost B without S, or compost A with S in increasing grain dry matter. On the other hand, compost B with S was significantly superior to that without S in increasing grain dry matter. The superiority of compost A without S over unmanured (untreated) or compost B without S was also found in case of the whole plant. Grain dry matter yield resulted from treatment of compost A combined with phosphorus was significantly higher than the other treatments. From other wise, grain dry matter yield of plants received S and P was significantly higher than that received S only. The triple interaction effect was found to be insignificant in all cases of maize dry matter yield. Similar results were obtained by El-Fayoumy *et al.* (2001), who attributed the insignificancy to the N assimilation by micro organisms.

**Nitrogen-uptake**

Data present in Table (4) show values of N-uptake by different parts of both the studied plants as influenced by different treatments. The obtained data revealed that there were significant increases in N-uptake by all parts of faba bean plant over the control treatment due to compost A application and N-uptake by straw and whole plant due to the another compost. However, compost A was significantly superior to another one (B) in all parts of faba bean plant. Nitrogen –uptake by faba bean seeds, straw and whole plant increased significantly with application of S or P.

Concerning the interaction effects of these factors, it could be noticed that the addition of S or P raised compost B efficiency to be as significant as compost A in case of seeds and whole faba bean plant.

With regard to triple interaction, statistical analyses presented in Table (4) revealed that there were no significant differences in increasing N-uptake in case of straw and whole faba bean plant.

Generally, the increase in uptake of nitrogen in tested plants may be attributed to the applied materials (composts, S and P) that increased the soil N content and availability. These results are nearly similar to those found by El-Maghraby *et al.* (1977), Arisha and Abd El-Bary (2000), Negm et al.(2001,2002,a,b,c and 2003) who found that application of compost and S or P increased N-uptake by tested crops. They attributed that to the improvement of soil properties, beside nitrogen released from organic matter (compost) by micro-organisms, consequently compost acts as nitrogenous fertilizer.

Table 3. Effect of compost( C), sulphur(S) and phosphorus(P) on dry matter yields of faba bean and maize plants (g/plant)

| Parts | Compost ( C) | $S_0$ | | | $S_1$ | | | P mean | | C mean | L.S.D. (at 0.05 level) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $P_0$ | $P_1$ | Mean | $P_0$ | $P_1$ | mean | $P_0$ | $P_1$ | | | |
| Faba bean | | | | | | | | | | | | |
| Seeds | 0 | 27.88 | 26.75 | 27.32 | 28 39 | 28.95 | 28.67 | 28.14 | 27.85 | 27.99 | C: 2.39 | C x S: 2.34 |
| | A | 31.04 | 30.85 | 30.95 | 30 53 | 31.54 | 31.04 | 30.79 | 31.20 | 30.99 | S: 1.35 | C x P: n.s |
| | B | 30 65 | 30.06 | 30.36 | 34 50 | 32.86 | 33.68 | 32.58 | 31.46 | 32.02 | P: n.s | S x P: n.s |
| | mean | 29.86 | 29.22 | 29.54 | 31 14 | 31.12 | 31.13 | 30.50 | 30.17 | | CxSxP:2.54 | |
| Straw | 0 | 104.99 | 109 39 | 107.19 | 109.78 | 112.92 | 111.35 | 107.39 | 111.16 | 109.27 | C: 5.05 | C x S: 6.46 |
| | A | 115.14 | 124.11 | 119.63 | 130.52 | 133.84 | 132.18 | 122.83 | 128.98 | 125.90 | S: 3.73 | C x P: n.s |
| | B | 120.71 | 115.92 | 118.32 | 115 95 | 121.22 | 118.59 | 118.33 | 118.57 | 118.45 | P: n.s | S x P: n.s |
| | mean | 113.61 | 116.47 | 115.04 | 118.75 | 122.66 | 120.71 | 116.18 | 119.57 | | CxSxP:8.14 | |
| Whole plant | 0 | 132.87 | 136.14 | 134.51 | 138 17 | 141.87 | 140.02 | 135.52 | 139.01 | 137.26 | C: 4.92 | C x S: 7.36 |
| | A | 146.18 | 154.96 | 150.57 | 161.05 | 165.38 | 163.22 | 153.62 | 160.17 | 156.89 | S: 4.25 | C x P: n.s |
| | B | 151.36 | 145.98 | 148.67 | 150.45 | 154.08 | 152.27 | 150.91 | 150.03 | 150.47 | P: n.s | S x P: n.s |
| | mean | 143.47 | 145.69 | 144.58 | 149.89 | 153.78 | 151.84 | 146.68 | 149.74 | | CxSxP:11.09 | |
| Maize | | | | | | | | | | | | |
| Grains | 0 | 136.58 | 127.74 | 132.16 | 141.20 | 139.77 | 140.49 | 138.89 | 133.76 | 136.32 | C: n.s | C x S: 10.32 |
| | A | 142.79 | 158.64 | 150.72 | 118.57 | 150.55 | 134.56 | 130.68 | 154.62 | 142.64 | S: n.s | C x P: 13.30 |
| | B | 140.33 | 129.18 | 134.76 | 139.13 | 151.90 | 145.52 | 139.73 | 140.54 | 140.14 | P: n.s | S x P: 10.86 |
| | mean | 139.90 | 138.52 | 139.21 | 132.97 | 147.44 | 140.19 | 136.43 | 142 97 | | CxSxP:n.s | |
| Stover | 0 | 147.62 | 140.88 | 144.25 | 132.42 | 162.13 | 147.28 | 140.02 | 151.51 | 145.77 | C: n.s | C x S: n.s |
| | A | 148.20 | 143.46 | 145.83 | 144.84 | 154.74 | 149.79 | 146.52 | 149.10 | 147.81 | S: n.s | C x P: n.s |
| | B | 136.75 | 153.28 | 145.02 | 148.07 | 149.65 | 148.86 | 142.41 | 151.47 | 146.94 | P: n.s | S x P: n.s |
| | mean | 144.19 | 145.87 | 145.03 | 141.78 | 155.51 | 148.65 | 142.98 | 150.69 | | CxSxP:n.s | |
| Whole plant | 0 | 284.20 | 268.62 | 276.41 | 273.62 | 301.90 | 287.76 | 278.91 | 285.26 | 282.09 | C: n.s | C x S: 16.85 |
| | A | 290.99 | 302.10 | 296.55 | 263.41 | 305.29 | 284.35 | 277.20 | 303.70 | 290.45 | S: n.s | C x P: n.s |
| | B | 277.08 | 282.46 | 279.77 | 287.20 | 301.55 | 294.38 | 282.14 | 292.01 | 287.08 | P: n.s | S x P: n.s |
| | mean | 284.09 | 284.39 | 284.24 | 274.75 | 302.92 | 288.83 | 279.42 | 293.66 | | CxSxP: n.s | |

0 = no addition, A and B= 4 ton/fed of compost A and B, respectively

$S_0$, $P_0$ = not added, $S_1$ and $P_1$ : 200 and 13.5 kg S and P/fed. respectively

**Table 4. Effect of compost( C), sulphur( S) and phosphorus(P ) on nitrogen uptake by faba bean and maize plants (mg/plant)**

| Parts | Compost (C) | $S_0$ $P_0$ | $S_0$ $P_1$ | $S_0$ mean | $S_1$ $P_0$ | $S_1$ $P_1$ | $S_1$ mean | P mean $P_0$ | P mean $P_1$ | C mean | L.S.D. (at 0.05 level) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Faba bean** | | | | | | | | | | | |
| Seeds | 0 | 1299.32 | 1384.86 | 1342.09 | 1434.96 | 1560.85 | 1497.91 | 1367.14 | 1472.86 | 1419.99 | C 171.77 CxS: n.s |
| | A | 1529.84 | 1782.84 | 1656.34 | 1833.05 | 2022.04 | 1927.55 | 1681.45 | 1902.44 | 1791.94 | S 72.57 CxP: n.s |
| | B | 1368.33 | 1454.61 | 1411.47 | 1718.67 | 1783.78 | 1751.23 | 1543.50 | 1619.20 | 1581.35 | P: 110.56 SxP: n.s |
| | mean | 1399.16 | 1540.77 | 1469.97 | 1662.22 | 1788.89 | 1725.56 | 1530.69 | 1664.83 | | CxSxP:230 |
| Straw | 0 | 1331.18 | 1320.28 | 1325.73 | 1332.68 | 1290.65 | 1311.67 | 1331.93 | 1305.47 | 1318.70 | C 65.67 CxS: 98.76 |
| | A | 1685.63 | 1785.98 | 1735.81 | 1587.90 | 1888.44 | 1738.17 | 1636.77 | 1837.21 | 1736.99 | S. 57.02 CxP. 91.07 |
| | B | 1487.12 | 1552.15 | 1519.64 | 1676.65 | 1887.36 | 1782.01 | 1581.88 | 1719.76 | 1650.82 | P: 52.58 SxP: 74.36 |
| | mean | 1501.31 | 1552.80 | 1527.06 | 1532.41 | 1688.82 | 1610.62 | 1516.86 | 1620.81 | | CxSxP:128 |
| Whole plant | 0 | 2630.50 | 2705.14 | 2667.82 | 2767.64 | 2851.50 | 2809.58 | 2699.07 | 2778.33 | 2738.70 | C: 169.94 CxS: 170.81 |
| | A | 3215.47 | 3568.82 | 3392.15 | 3420.95 | 3910.48 | 3665.72 | 3318.22 | 3739.65 | 3528.94 | S: 98.62 CxP. n.s |
| | B | 2855.45 | 3006.76 | 2931.11 | 3395.32 | 3671.14 | 3533.24 | 3125.38 | 3338.96 | 3232.18 | P. 136.55 SxP: n.s |
| | mean | 2900.47 | 3093.57 | 2997.03 | 3194.64 | 3477.71 | 3336.18 | 3047.56 | 3285.64 | | CxSxP:334 |
| **Maize** | | | | | | | | | | | |
| Grains | 0 | 1341.33 | 1414.08 | 1377.71 | 1412.00 | 1322.20 | 1367.10 | 1376.67 | 1368.14 | 1372.40 | C: 222.13 CxS: 114.78 |
| | A | 1453.55 | 2005.18 | 1729.37 | 1489.19 | 1936.11 | 1712.65 | 1471.37 | 1970.65 | 1721.01 | S: 66.27 CxP: 156.63 |
| | B | 1502.88 | 1406.75 | 1454.82 | 1739.11 | 1736.25 | 1737.68 | 1620.99 | 1571.50 | 1596.25 | P: 90.43 SxP: n.s |
| | mean | 1432.59 | 1608.67 | 1520.63 | 1546.77 | 1664.85 | 1605.81 | 1489.68 | 1636.76 | | CxSxP:22.1 |
| Stover | 0 | 393.87 | 399.75 | 396.81 | 464.80 | 489.70 | 477.25 | 429.34 | 444.73 | 437.03 | C: 103.39 CxS: n.s |
| | A | 627.71 | 625.26 | 648.99 | 620.15 | 677.04 | 648.60 | 646.43 | 651.15 | 848.79 | S: 84.6 CxP: n.s |
| | B | 761.23 | 887.17 | 824.20 | 984.63 | 1025.02 | 1004.83 | 872.93 | 956.10 | 914.52 | P: n.s SxP: n.s |
| | mean | 609.27 | 637.39 | 623.33 | 689.87 | 730.59 | 710.23 | 649.57 | 883.99 | | CxSxP:170 |
| Whole plant | 0 | 1735.20 | 1813.82 | 1774.51 | 1876.80 | 1811.90 | 1844.35 | 1806.01 | 1812.87 | 1809.43 | C: 294.11 CxS: 144.61 |
| | A | 2126.26 | 2630.44 | 2378.36 | 2109.33 | 2613.15 | 2361.24 | 2117.80 | 2621.80 | 2369.80 | S: 83.49 CxP: 216.19 |
| | B | 2264.11 | 2293.92 | 2279.02 | 2723.75 | 2761.27 | 2742.51 | 2493.92 | 2527.60 | 2510.77 | P: 125.97 SxP: n.s |
| | mean | 2041.86 | 2246.06 | 2143.46 | 2236.65 | 2395.44 | 2316.04 | 2139.25 | 2320.75 | | CxSxP: 308 |
| **Faba bean + maize (mg/both plants)** | | | | | | | | | | | |
| Total uptake | 0 | 4365.70 | 4518.96 | 4442.33 | 4644.44 | 4663.40 | 4653.92 | 4505.07 | 4591.18 | 4548.13 | C: 441.68 CxS: 255.49 |
| | A | 5341.72 | 6199.26 | 5770.49 | 5530.28 | 6523.63 | 6026.96 | 5436.00 | 6361.45 | 5898.75 | S: 147.50 CxP: 329.04 |
| | B | 5119.56 | 5300.68 | 5210.12 | 6119.07 | 6432.41 | 6275.74 | 5619.32 | 5866.55 | 5742.95 | P: 169.97 SxP: n.s |
| | mean | 4942.33 | 5339.63 | 5140.98 | 5431.27 | 5873.15 | 5652.21 | 5186.80 | 5606.39 | | CxSxP: 465 |

0 = no addition, A and B= 4 ton/fed of compost A and B. respectively.

$S_0$, $P_0$ = not added, $S_1$ and $P_1$ : 200 and 13.5 kg S and P/fed. respectively.

Data in the same table indicated that N-uptake by different parts of maize plant was affected significantly by the residual effect of the individual applied treatments except for P in case of stover. However, residual effect of compost B was significantly superior to the other one (A) in increasing N-uptake by maize stover. The statistical analyses revealed that there was no significant difference effect between effect of compost A combined with S or P and compost B combined with S or P in N-uptake by maize stover. This may be due to addition of S or P that raised compost A efficiency to be as significant as compost B. The same observation of beneficial effect of sulphur addition to compost B was observed in case of whole maize plant. At the same time, addition of phosphorus to compost A tended to cause significant increase in N-uptake by maize grain over that of compost B with P.

It is obvious from the same table that the total N taken up by both the tested whole crops followed the same behavior of them.

**Phosphorus uptake**

Data presented in Table (5) indicated that addition of any of the two used composts caused significant positive effects on P-uptake by different parts of tested plants for the two cultivation seasons. However, no significant differences were found between compost A and B on P-uptake in all parts of the tested plants. On the other hand, application of sulphur resulted in significant decreases in P-uptake by faba bean straw and the whole plant, but the residual effect of sulphur was found to be insignificant on P-uptake by all parts of maize plant.

Data proved that the application of phosphorus to soil tended to cause a significant increase on P-uptake by all parts of both the used plants as compared with the control treatment. At the same time, the triple interaction was of significant effect in increasing P-uptake by all parts of both the tested plants. Addition of sulphur with compost B was found to be significantly superior to compost A combined with S in increasing P-uptake by all parts of faba bean. The significant increases in P-uptake by straw and whole faba bean plant attained due to compost A combined with P were higher than those attained due to compost B with P. Averaged over P, application of compost B without S was significantly superior to that treated with compost A combined with S in increasing P-uptake by maize grains.

These results may be attributed to the effect of the studied factors on dry matter yield. These findings are in agreement with those reported by Ramadan *et al.* (1996), El-Fayoumy (1996) and Negm *et al.*(2002b), who found that application of organic matter with S results in an increase in P-uptake by tested crops. The obtained data revealed that P-uptake by different parts of maize plant were higher than the corresponding ones attained by faba bean plant. This result may be due to available P which was increased at that period by addition of studied treatments (Awad *et al.*,2000 and Negm *et al.*,2003)

Regarding the total P taken up by both crops as a whole, treated with the mixture of composts, S and P was significantly higher than that of treatment received S and P without composts.

Table 5. Effect of compost(C ), sulphur( S) and phosphorus( P) on phosphorus uptake by faba bean and maize plants (mg/plant)

| Parts | Compost (C) | $S_0$ | | | $S_1$ | | | P mean | | C | L.S.D. (at 0.05 level) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $P_0$ | $P_1$ | mean | $P_0$ | $P_1$ | mean | $P_0$ | $P_1$ | mean | | |
| **Faba bean** | | | | | | | | | | | | |
| Seeds | 0 | 175.66 | 167.16 | 171.41 | 167.78 | 161.53 | 164.66 | 171.72 | 164.35 | 166.03 | C 34.86 | C x S: 17.71 |
| | A | 230.00 | 280.89 | 255.35 | 226.23 | 281.03 | 253.63 | 228.12 | 280.86 | 254.49 | S n.s | C x P. 30.32 |
| | B | 231.72 | 268.13 | 249.93 | 267.40 | 281.31 | 274.36 | 249.56 | 274.72 | 262.14 | P. 17.51 | S x P: n.s |
| | mean | 212.46 | 238.66 | 225.56 | 220.47 | 241.29 | 230.88 | 216.46 | 239.98 | | CxSxP:42.89 | |
| Straw | 0 | 95.53 | 166.26 | 130.90 | 81.23 | 140.03 | 110.63 | 88.38 | 153.15 | 120.76 | C: 5.79 | C x S: 10.12 |
| | A | 162.33 | 245.69 | 204.01 | 117.45 | 188.70 | 153.08 | 139.89 | 217.20 | 178.54 | S 5.84 | C x P: 12.16 |
| | B | 150.89 | 183.18 | 167.04 | 143.78 | 190.31 | 167.05 | 147.34 | 186.75 | 167.04 | P 7.05 | S x P: n.s |
| | mean | 136.25 | 198.38 | 167.32 | 114.15 | 173.01 | 143.58 | 125.21 | 185.70 | | CxSxP:17.71 | |
| Whole plant | 0 | 271.19 | 333.42 | 302.31 | 249.01 | 301.56 | 275.29 | 260.10 | 317.50 | 288.79 | C: 36.18 | C x S: 22.80 |
| | A | 392.33 | 526.38 | 459.36 | 343.68 | 469.73 | 406.71 | 368.01 | 498.06 | 433.03 | S: 13.17 | C x P: 35.14 |
| | B | 382.61 | 451.31 | 416.97 | 411.18 | 471.62 | 441.41 | 396.90 | 461.47 | 429.18 | P 20.29 | S x P: n.s |
| | mean | 348.71 | 437.03 | 392.88 | 334.62 | 414.30 | 374.47 | 341.67 | 425.68 | | CxSxP:49.70 | |
| **Maize** | | | | | | | | | | | | |
| Grains | 0 | 352.40 | 371.74 | 362.07 | 457.51 | 526.51 | 492.01 | 404.96 | 449.13 | 427.04 | C: 135.35 | C x S: 63.46 |
| | A | 676.80 | 804.29 | 740.55 | 541.85 | 788.91 | 665.38 | 609.33 | 796.60 | 702.97 | S. n.s | C x P: 79.69 |
| | B | 618.83 | 914.60 | 766.72 | 683.13 | 768.62 | 725.88 | 650.98 | 841.61 | 746.29 | P: 46.01 | S x P: n.s |
| | mean | 549.34 | 696.88 | 623.11 | 560.83 | 694.68 | 627.76 | 555.09 | 695.78 | | CxSxP:112.70 | |
| Stover | 0 | 122.92 | 160.61 | 141.77 | 97.99 | 119.98 | 108.99 | 110.46 | 140.30 | 125.38 | C: 21.58 | C x S: 29.60 |
| | A | 145.95 | 163.54 | 154.75 | 156.43 | 184.51 | 170.47 | 151.19 | 174.03 | 162.61 | S n.s | C x P: n.s |
| | B | 124.44 | 159.30 | 141.87 | 156.92 | 158.09 | 157.51 | 140.68 | 158.7 0 | 149.68 | P: 14.66 | S x P: n.s |
| | mean | 131.10 | 161.15 | 146.13 | 137.11 | 154.19 | 145.85 | 134.11 | 157.68 | | CxSxP:35.9 | |
| Whole plant | 0 | 475.32 | 532.35 | 503.84 | 555.50 | 646.48 | 600.99 | 515.42 | 589.42 | 552.42 | C: 132.49 | C x S: 63.88 |
| | A | 822.75 | 967.83 | 895.29 | 698.28 | 973.41 | 836.15 | 760.52 | 970.63 | 865.58 | S n.s | C x P: 86.52 |
| | B | 743.27 | 1073.90 | 908.59 | 840.05 | 926.71 | 883.33 | 791.66 | 1000.31 | 895.97 | P: 49.95 | S x P: n.s |
| | mean | 680.44 | 858.03 | 769.23 | 697.94 | 848.87 | 773.41 | 689.20 | 853.46 | | CxSxP: 122.35 | |
| **Faba bean + maize (mg/both plants)** | | | | | | | | | | | | |
| Total uptake | 0 | 746.50 | 865.77 | 806.14 | 804.51 | 948.03 | 876.27 | 775.51 | 906.90 | 841.21 | C 162 | C x S: 71.24 |
| | A | 1215.08 | 1494.21 | 1354.65 | 1042.56 | 1443.14 | 1242.85 | 1128.82 | 1466.68 | 1298.61 | S. n s | C x P: 102.54 |
| | B | 1125.88 | 1525.21 | 1325.55 | 1251.13 | 1398.33 | 1324.73 | 1188.51 | 1461.77 | 1325.15 | P: 59.20 | S x P: n.s |
| | mean | 1029.14 | 1295.06 | 1162.10 | 1032.56 | 1263.17 | 1147.87 | 1030.94 | 1279.11 | | CxSxP: 145.02 | |

0 = no addition, A and B= 4 ton/fed of compost A and B, . respectively.

$S_0$, $P_0$ = not added, $S_1$ and $P_1$ : 200 and 13.5 kg S and P/fed. respectively

**Potassium-uptake**

Data presented in Table (6) show the mean values of K-uptake by different parts of faba bean and maize plants.

As for faba bean, K-uptake of seeds and straw significantly increased due to application of any of the two used composts. However, compost B was significantly superior to the other one (A) in case of straw and whole faba bean plant. Application of sulphur or phosphorus was significantly beneficial in increasing K-uptake by straw and whole faba bean plant. On the other hand, the triple interaction between these three factors was found to be insignificant on K-uptake by different parts of faba bean plant. The K-uptake by seeds of faba bean plant attained due to compost B combined with S was higher than the corresponding K-uptake value attained due to compost A combined with S. However, statistical analyses revealed that the addition of phosphorus raised compost A efficiency to be as the same as compost B in case of straw and whole faba bean plant.

Also, data revealed that there was a significant increase in K-uptake by all parts of maize plant due to residual effect of compost A as compared with the control treatment while grains were the only plant part which was positively sensitive to the other compost (B). However, residual effect of compost A was significantly superior to B in increasing K-uptake by all parts of maize plants. Also, mean values of K-uptake by maize grains were significantly increased due to the residual effects of S and /or P. On the other hand, triple interaction was insignificant on K-uptake by all parts of maize plant.

This increase in K-uptake by both used plants may be due to the high content of potassium in both the tested composts and their effect on conserving K from being lost by leaching. Similar results were obtained by Negm *et al.*(2002a, b and 2003).

**Iron-uptake**

Data in Table (7) indicated that Fe-uptake by different parts of faba bean plant was significantly increased due to application of any of the two used composts. However, compost A was significantly superior to compost B in all parts of faba bean plant. Application of sulphur resulted in significant increases in Fe-uptake by seeds and whole faba bean plant and significantly reversed in case of straw. On the other hand, application of P caused significant decrease in Fe-uptake by all parts of faba bean plant (19.82 vs 15.92 for seeds, 46.09 vs 39.57 mg/plant for straw). Moreover, statistical analyses revealed that the negative effect of S application on Fe-uptake by faba bean straw was reduced due to application of compost A combined with sulphur.

Mean values of Fe-uptake by different parts of maize plant were significantly increased over the control treatment due to compost A or B application. One exception was the Fe-uptake by stover attained due to application of compost B, where its values did not exceed that of the control (Table 7). Application of S or P was significantly beneficial in increasing Fe-uptake by grains and whole maize plant. Moreover, statistical analyses clarified that the addition of S combined with compost B caused significant increase in Fe-uptake by grains over that of compost A combined with S. On the contrary, application of P with compost A raised significantly Fe-uptake by grains and whole maize plant over that of compost B. This may be due to chemical composition of the used composts and relative effect of S which decreased the soil pH, consequently increased availability of Fe element. These findings are in agreement with those reported by Awad *et al.*(1996) and Negm *et al.*(2003).

**Manganese-uptake**

The mean values of Mn-uptake by different parts of both used crops are presented in Table (8).

Manganese uptake by parts of faba bean plant was significantly increased by application of any of the two used composts. However, compost B was significantly superior to compost A. Application of S was of positive and significant effect on increasing Mn-uptake by seeds but at the same time it was of negative and significant effect on Mn-uptake by straw and whole faba bean plant. On the other hand, phosphorus effect was found to be insignificant on Mn-uptake by faba bean plant.

With regard to the double interaction of these factors, statistical analyses revealed that compost A combined with P was of significant and superior effect to that without P on increasing Mn-uptake by all parts of faba bean plant. From other wise, manganese uptake by straw received S and P was significantly higher than that received S only. The triple interaction effect was significant on Mn-uptake by faba bean plant. Similar results were reported by Awad *et al.* (1996) and Negm *et al.*(2002b).

Data in the same table also revealed that Mn-uptake by maize plant increased significantly due to application of any of the two used composts, sulphur or phosphorus. However, compost B was significantly superior to compost A which may be due to its chemical composition (Table 2).

Regarding the double interaction between compost and phosphorus, addition of P raised compost A efficiency to be as significant as compost B with P in increasing Mn-uptake by stover and whole plant. The interaction effects of these three factors were also significant.

**Zn-uptake**

Data presented in Table (9) showed that the mean values of Zn taken up by different parts of faba bean plant were significantly increased over the control treatment due to composts applications with the exception of seeds of the plants treated with compost A. However, compost B was significantly superior to compost A. Nevertheless, Zn-uptake by straw and the whole faba bean plant was significantly decreased with application of S, but application of P was significantly beneficial in increasing Zn-uptake by straw and the whole plant.

Concerning the double interaction of these factors, data in Table (9) also revealed that sulphur application significantly increased Zn-uptake by seeds of plants treated with compost B. From other wise, compost A and S interaction was found to be of insignificant effect on Zn-uptake by straw and the whole plant compared with compost A alone.

Table 6. Effect of compost( C), sulphur( S) and phosphorus( P) on potassium uptake by faba bean and maize plants (mg/plant)

| Parts | Compost (C) | $S_0$ | | | $S_1$ | | | P mean | | C | L.S.D. (at 0.05 level) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $P_0$ | $P_1$ | mean | $P_0$ | $P_1$ | mean | $P_0$ | $P_1$ | mean | | |
| Faba bean | | | | | | | | | | | | |
| Seeds | 0 | 430.42 | 451 45 | 440.94 | 480 13 | 503.98 | 492 06 | 455 28 | 477.72 | 466.50 | C: 92 52 | C x S: 52.91 |
| | A | 700 83 | 714 06 | 707.45 | 620 68 | 678.43 | 649 56 | 660 76 | 696.25 | 678 50 | S n.s | C x P n.s |
| | B | 776 10 | 748 79 | 762.45 | 742 07 | 750.25 | 746 16 | 759.09 | 749.52 | 754 30 | P. n.s | S x P: n s |
| | mean | 635 78 | 638 10 | 636 94 | 614 29 | 644 2 | 629.26 | 625.04 | 641.16 | | CxSxP: n.s | |
| Straw | 0 | 2578 43 | 2651 50 | 2614.97 | 3128 59 | 3355.98 | 3242.29 | 2853 51 | 3003.74 | 2928.62 | C. 192.62 | C x S: 224.43 |
| | A | 3581 25 | 3895.88 | 3738.57 | 3766 88 | 4408 63 | 4087 76 | 3674.07 | 4152.26 | 3913.16 | S. 129.58 | C x P: n.s |
| | B | 4180 38 | 4237.93 | 4209.16 | 4307 53 | 4412.33 | 4359.93 | 4243.96 | 4325.13 | 4284 54 | P: 136.64 | S x P: n.s |
| | mean | 3446 68 | 3595.10 | 3520.88 | 3734.33 | 4058 98 | 3896 66 | 3590 51 | 3827.04 | | CxSxP: n.s | |
| Whole plant | 0 | 3008 85 | 3102 95 | 3055 91 | 3608 72 | 3859 96 | 3734.35 | 3308.79 | 3481.46 | 3395.12 | C: 237.04 | C x S: 229.74 |
| | A | 4282 08 | 4609.94 | 4446.02 | 4387 56 | 5087.06 | 4737.32 | 4334.83 | 4848.51 | 4591 66 | S. 132.64 | C x P: n.s |
| | B | 4956.48 | 4986.72 | 4971.61 | 5049.60 | 5162.58 | 5106.09 | 5003.05 | 5074.65 | 5038 84 | P. 157.63 | S x P. n.s |
| | mean | 4081.86 | 4233.20 | 4157.82 | 4348.62 | 4703 20 | 4525 92 | 4215.55 | 4468.20 | | CxSxP: n.s | |
| Maize | | | | | | | | | | | | |
| Grains | 0 | 374.28 | 361.60 | 367.94 | 386.80 | 399.75 | 393.28 | 380 54 | 380.68 | 380.61 | C: 71.83 | C x S: 104.61 |
| | A | 474 05 | 634.55 | 554 30 | 637 88 | 831 05 | 734 47 | 555.97 | 732.80 | 644.38 | S: 60.40 | C x P: 78.01 |
| | B | 420.98 | 656.25 | 538.62 | 489.75 | 548.03 | 518 89 | 455.37 | 602.14 | 528.75 | P: 45.04 | S x P: n.s |
| | mean | 423.10 | 550.80 | 486.95 | 504 81 | 592 95 | 548.88 | 463.96 | 571.87 | | CxSxP:n.s | |
| Stover | 0 | 2662.18 | 3334.53 | 2998 36 | 2733 05 | 3255.69 | 2994.37 | 2697 62 | 3295.11 | 2996.36 | C. 391.33 | C x S: n.s |
| | A | 3232 83 | 3596.03 | 3414 43 | 3778 51 | 3676.79 | 37227.65 | 3505.67 | 3636.41 | 3571.04 | S. n s | C x P: n.s |
| | B | 3047.94 | 2986.31 | 3017.13 | 3184.03 | 3239.19 | 3211.61 | 3115.99 | 3112 75 | 3114.37 | P n.s | S x P: n.s |
| | mean | 2980.98 | 3305 62 | 3143 30 | 3231 86 | 3390.55 | 3311.21 | 3106.42 | 3348.09 | | CxSxP: n.s | |
| Whole plant | 0 | 3036 46 | 3696.13 | 3366 30 | 3119.85 | 3655.44 | 3387.65 | 3078.16 | 3675.79 | 3376.97 | C: 514.25 | C x S: n.s |
| | A | 3706.88 | 4230.58 | 3968.73 | 4416.39 | 4507.84 | 4462 12 | 4061.64 | 4369.21 | 4215 42 | S: n.s | C x P: n.s |
| | B | 3468.92 | 3642.56 | 3555.75 | 3673.78 | 3787.22 | 3730.50 | 3571.36 | 3714.89 | 3643.12 | P. n s | S x P: n.s |
| | mean | 3404 08 | 3856 42 | 3630 25 | 3736 67 | 3983.50 | 3860 09 | 3570 38 | 3919.96 | | CxSxP: 308 | |
| Faba bean + maize (mg/both plants) | | | | | | | | | | | | |
| Total uptake | 0 | 6045.31 | 6799.08 | 6422.20 | 6728 57 | 7515 40 | 7122.00 | 6386.95 | 7157.25 | 6772 09 | C: 480.74 | C x S: n.s |
| | A | 7988 96 | 8840 52 | 8414.75 | 8803.95 | 9594.89 | 9199.45 | 8396.47 | 9217.72 | 8807.08 | S. 280.01 | C x P: n.s |
| | B | 8425 40 | 8629 28 | 8527.35 | 8723 37 | 8949.80 | 8836 59 | 8574 41 | 8789.54 | 8681 90 | P: 409.03 | S x P: n.s |
| | mean | 7485.94 | 8089.62 | 7788 10 | 8085.29 | 8686.70 | 8386.01 | 7785 93 | 8388.16 | | CxSxP: n.s | |

0= no addition, A and B= 4 ton/fed of compost A and B, . respectively

$S_0$, $P_0$ = not added, $S_1$ and $P_1$ : 200 and 13.5 kg S and P/fed. respectively

Table 7. Effect of compost( C), sulphur( S) and phosphorus( P) on iron uptake by faba bean and maize plants (mg/plant)

| Parts | Compost (C) | $S_0$ $P_0$ | $S_0$ $P_1$ | $S_0$ mean | $S_1$ $P_0$ | $S_1$ $P_1$ | $S_1$ mean | P mean $P_0$ | P mean $P_1$ | C mean | L.S.D. (at 0.05 level) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Faba bean** | | | | | | | | | | | | |
| Seeds | 0 | 11.15 | 10.70 | 10.93 | 16.79 | 15.77 | 16.28 | 13.97 | 13.25 | 13.60 | C 2.67 | C x S: 1.78 |
| | A | 24.51 | 18.04 | 21.28 | 31.05 | 19.72 | 25.38 | 27.78 | 16.66 | 23.33 | S. 1.03 | C x P: 1.99 |
| | B | 15.52 | 13.88 | 14.70 | 19.88 | 17.37 | 18.62 | 17.70 | 15.63 | 16.66 | P 1.15 | S x P: 1.63 |
| | mean | 17.06 | 14.21 | 15.64 | 22.57 | 17.62 | 20.09 | 19.82 | 15.92 | | CxSxP:2.82 | |
| Straw | 0 | 36.21 | 23.18 | 29.70 | 23.19 | 24.24 | 23.72 | 29.70 | 23.71 | 26.71 | C: 4.69 | C x S: 2.13 |
| | A | 57.57 | 49.65 | 53.61 | 54.64 | 56.46 | 55.68 | 56.23 | 53.06 | 54.64 | S. 1.23 | C x P: 2.86 |
| | B | 52.49 | 43.75 | 48.12 | 52.20 | 40.15 | 46.18 | 52.35 | 41.95 | 47.15 | P: 1.65 | S x P: 2.33 |
| | mean | 48.76 | 38.86 | 43.81 | 43.43 | 40.28 | 41.86 | 46.09 | 39.57 | | CxSxP:4.0 | |
| Whole plant | 0 | 47.36 | 33.88 | 40.63 | 39.98 | 40.01 | 40.00 | 43.67 | 36.94 | 40.31 | C: 3.08 | C x S: 3.29 |
| | A | 82.08 | 67.69 | 74.89 | 85.94 | 76.18 | 81.06 | 84.01 | 71.94 | 77.97 | S: 1.91 | C x P: 3.30 |
| | B | 68.01 | 57.63 | 62.82 | 72.08 | 57.52 | 64.80 | 70.05 | 57.58 | 63.81 | P: 1.90 | S x P: 2.69 |
| | mean | 65.82 | 53.07 | 59.45 | 66.00 | 57.90 | 61.95 | 65.91 | 55.49 | | CxSxP:4.65 | |
| **Maize** | | | | | | | | | | | | |
| Grains | 0 | 68.30 | 71.63 | 69.97 | 70.60 | 83.86 | 77.23 | 69.45 | 77.75 | 73.60 | C: 18.25 | C x S: 7.53 |
| | A | 85.67 | 126.91 | 106.29 | 82.99 | 135.50 | 109.25 | 84.33 | 131.21 | 107.77 | S: 4.35 | C x P: 10.23 |
| | B | 98.23 | 103.34 | 100.79 | 111.30 | 136.71 | 124.01 | 104.77 | 120.03 | 112.39 | P: 5.91 | S x P. 8.35 |
| | mean | 84.07 | 100.63 | 92.35 | 88.30 | 118.69 | 103.50 | 86.19 | 109.66 | | CxSxP:14.47 | |
| Stover | 0 | 29.50 | 28.18 | 28.84 | 26.48 | 32.43 | 29.46 | 27.99 | 30.31 | 29.15 | C: 4.36 | C x S: n.s |
| | A | 37.94 | 35.51 | 36.73 | 40.19 | 42.81 | 41.50 | 39.07 | 39.16 | 39.11 | S: n.s | C x P: n.s |
| | B | 34.59 | 30.66 | 32.63 | 29.61 | 29.93 | 29.77 | 32.10 | 30.30 | 31.20 | P: n.s | S x P: n.s |
| | mean | 34.02 | 31.45 | 32.74 | 32.09 | 35.05 | 33.57 | 33.06 | 33.25 | | CxSxP:n.s | |
| Whole plant | 0 | 97.80 | 99.81 | 98.81 | 97.08 | 116.29 | 106.69 | 97.44 | 108.05 | 102.75 | C. 19.69 | C x S: 10.29 |
| | A | 123.61 | 162.42 | 143.02 | 123.18 | 178.31 | 150.75 | 123.40 | 170.37 | 146.88 | S: 5.94 | C x P: 13.82 |
| | B | 132.82 | 134.00 | 133.41 | 140.91 | 166.64 | 153.78 | 136.87 | 150.32 | 143.59 | P: 7.98 | S x P: 11.28 |
| | mean | 118.09 | 132.08 | 125.09 | 120.39 | 153.74 | 137.07 | 119.24 | 142.91 | | CxSxP: n.s | |
| **Faba bean + maize (mg/both plants)** | | | | | | | | | | | | |
| Total uptake | 0 | 145.16 | 133.69 | 139.44 | 137.06 | 156.30 | 146.69 | 141.11 | 144.99 | 143.06 | C. 17.74 | C x S: 10.22 |
| | A | 205.69 | 230.11 | 217.91 | 209.12 | 254.49 | 231.81 | 207.41 | 242.31 | 224.85 | S: 5.90 | C x P: 14.42 |
| | B | 200.83 | 191.63 | 196.23 | 212.99 | 224.16 | 218.58 | 206.92 | 207.90 | 207.40 | P. 8.33 | S x P: 11.78 |
| | mean | 183.89 | 185.14 | 184.53 | 186.39 | 212.65 | 199.03 | 185.15 | 198.40 | | CxSxP: n.s | |

0 = no addition, A and B= 4 ton/fed of compost A and B,.respectively.$S_0$, $P_0$ = not added, $S_1$ and $P_1$:200 and 13.5 kg S and P/fed.respectively

Table 8. Effect of compost( C), sulphur( S) and phosphorus( P) on manganese uptake by faba bean and maize plants (mg/plant)

| Parts | Compost (C) | $S_0$ | | | $S_1$ | | | P mean | | C mean | L.S.D. (at 0.05 level) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $P_0$ | $P_1$ | mean | $P_0$ | $P_1$ | mean | $P_0$ | $P_1$ | | | |
| **Faba bean** | | | | | | | | | | | | |
| Seeds | 0 | 2.93 | 2.51 | 2.72 | 2.21 | 1.83 | 2.02 | 5.57 | 2.17 | 2.37 | C: 0.79 | C x S: 0.31 |
| | A | 3.20 | 4.32 | 3.76 | 3.51 | 4.58 | 4.05 | 3.36 | 4.45 | 3.90 | S: 0.18 | C x P: 0.52 |
| | B | 4.02 | 4.63 | 4.33 | 6.62 | 6.02 | 6.32 | 5.32 | 5.33 | 5.32 | P: n.s | S x P: n.s |
| | mean | 3.38 | 3.82 | 3.60 | 4.11 | 4.14 | 4.12 | 3.75 | 3.98 | | CxSxP: 0.74 | |
| Straw | 0 | 6.72 | 6.23 | 6.48 | 5.93 | 5.99 | 5.96 | 6.33 | 6.11 | 6.22 | C: 0.64 | C x S: 0.55 |
| | A | 10.59 | 11.17 | 10.88 | 6.67 | 7.76 | 7.22 | 8.63 | 9.47 | 9.05 | S: 0.32 | C x P: 0.55 |
| | B | 16.42 | 14.95 | 15.69 | 8.70 | 8.97 | 8.84 | 12.56 | 11.96 | 12.26 | P: n.s | S x P: 0.45 |
| | mean | 11.24 | 10.78 | 11.02 | 7.10 | 7.57 | 7.34 | 9.17 | 9.18 | | CxSxP: 0.78 | |
| Whole plant | 0 | 9.65 | 8.74 | 9.20 | 8.14 | 7.82 | 7.98 | 8.90 | 8.28 | 8.59 | C: 1.34 | C x S: 0.64 |
| | A | 13.79 | 15.49 | 14.64 | 10.18 | 12.34 | 11.26 | 11.99 | 13.92 | 12.95 | S: 0.37 | C x P: 0.90 |
| | B | 20.44 | 19.58 | 20.01 | 15.32 | 14.99 | 15.16 | 17.88 | 17.29 | 17.58 | P: n.s | S x P: n.s |
| | mean | 14.62 | 14.60 | 14.61 | 11.21 | 11.71 | 11.46 | 12.92 | 13.16 | | CxSxP: 1.27 | |
| **Maize** | | | | | | | | | | | | |
| Grains | 0 | 4.78 | 5.49 | 5.14 | 5.93 | 6.15 | 6.04 | 5.36 | 5.82 | 5.59 | C: 2.19 | C x S: 0.81 |
| | A | 7.42 | 8.25 | 7.84 | 6.76 | 9.94 | 8.35 | 7.09 | 9.10 | 8.09 | S: 0.47 | C x P: 0.93 |
| | B | 9.96 | 9.43 | 9.69 | 12.10 | 14.58 | 13.34 | 11.03 | 12.01 | 11.52 | P: 0.54 | S x P: 0.75 |
| | mean | 7.39 | 7.72 | 7.56 | 8.26 | 10.22 | 9.24 | 7.83 | 8.97 | | CxSxP:1.31 | |
| Stover | 0 | 7.32 | 6.98 | 7.15 | 6.78 | 8.93 | 7.86 | 7.05 | 7.95 | 7.50 | C: 0.96 | C x S: 0.83 |
| | A | 8.34 | 7.75 | 8.05 | 9.61 | 11.21 | 10.41 | 8.98 | 9.48 | 9.23 | S: 0.48 | C x P: n.s |
| | B | 10.80 | 12.34 | 11.57 | 11.53 | 12.90 | 12.22 | 11.17 | 12.62 | 11.89 | P: 0.60 | S x P: 0.85 |
| | mean | 8.82 | 9.02 | 8.92 | 9.31 | 11.01 | 10.16 | 9.07 | 10.02 | | CxSxP:1.41 | |
| Whole plant | 0 | 12.10 | 12.47 | 12.29 | 12.71 | 15.08 | 13.90 | 12.41 | 13.78 | 13.09 | C: 2.41 | C x S: 1.01 |
| | A | 15.76 | 16.00 | 15.88 | 16.37 | 21.15 | 18.76 | 16.07 | 18.58 | 17.32 | S: 0.58 | C x P: n.s |
| | B | 20.76 | 21.77 | 21.27 | 23.63 | 27.48 | 25.56 | 22.20 | 24.63 | 23.41 | P: 0.91 | S x P: 1.29 |
| | mean | 16.21 | 16.75 | 16.48 | 17.57 | 21.23 | 19.40 | 16.89 | 18.99 | | CxSxP: 2.23 | |
| **Faba bean + maize (mg/both plants)** | | | | | | | | | | | | |
| Total uptake | 0 | 21.75 | 21.21 | 21.48 | 20.85 | 22.90 | 21.88 | 21.30 | 22.01 | 21.67 | C: 3.74 | C x S: n.s |
| | A | 29.55 | 31.49 | 30.52 | 26.55 | 33.49 | 30.02 | 28.05 | 32.49 | 30.27 | S: n.s | C x P: 1.86 |
| | B | 41.20 | 41.35 | 41.28 | 38.95 | 42.47 | 40.71 | 40.08 | 41.91 | 40.99 | P: 1.08 | S x P: 1.53 |
| | mean | 30.83 | 31.35 | 31.09 | 28.78 | 32.94 | 30.86 | 29.81 | 32.15 | | CxSxP: n.s | |

0 = no addition, A and B= 4 ton/fed of compost A and B, . respectively
$S_0$, $P_0$ = not added, $S_1$ and $P_1$ : 200 and 13.5 kg S and P/fed. respectively

Table 9. Effect of compost( C), sulphur( S) and phosphorus( P) on zinc uptake by faba bean and maize plants mg/plant)

| Parts | Compost | $S_0$ |  |  | $S_1$ |  |  | P mean |  | C | L.S.D. (at 0.05 level) |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | $P_0$ | $P_1$ | mean | $P_0$ | $P_1$ | mean | $P_0$ | $P_1$ | mean |  |
| **Faba bean** |  |  |  |  |  |  |  |  |  |  |  |
| Seeds | 0 | 0.864 | 0.856 | 0.860 | 0.795 | 0.869 | 0.832 | 0.830 | 0.863 | 0.846 | C. 0.181 C x S 0.075 |
|  | A | 0.964 | 0.894 | 0.929 | 0.764 | 0.789 | 0.777 | 0.864 | 0.842 | 0.853 | S: n.s C x P: n.s |
|  | B | 1.349 | 1.233 | 1.291 | 1.484 | 1.413 | 1.449 | 1.417 | 1.323 | 1.370 | P: n.s S x P: n.s |
|  | mean | 1.059 | 0.994 | 1.027 | 1.014 | 1.024 | 1.019 | 1.037 | 1.009 |  | CxSxP: n.s |
| Straw | 0 | 4.830 | 5.535 | 5.183 | 6.477 | 6.324 | 6.401 | 5.654 | 5.930 | 5.791 | C: 1.020 C x S. 0.556 |
|  | A | 7.484 | 7.943 | 7.714 | 7.346 | 8.967 | 8.157 | 7.415 | 8.455 | 7.935 | S 0.321 C x P: n.s |
|  | B | 16.899 | 19.126 | 18.013 | 10.436 | 11.152 | 10.794 | 13.667 | 15.139 | 14.403 | P. 0.407 S x P: n.s |
|  | mean | 9.738 | 10.868 | 10.303 | 8.086 | 8.814 | 8.450 | 8.912 | 9.841 |  | CxSxP:0.997 |
| Whole plant | 0 | 5.694 | 6.391 | 6.043 | 7.272 | 7.193 | 7.233 | 6.483 | 6.792 | 6.637 | C. 1.176 C x S: 0.573 |
|  | A | 8.448 | 8.837 | 8.643 | 8.110 | 9.758 | 8.933 | 8.279 | 9.297 | 8.788 | S: 0.331 C x P: n.s |
|  | B | 18.248 | 20.359 | 19.304 | 11.920 | 12.565 | 12.243 | 15.084 | 16.462 | 15.773 | P: 0.450 S x P: n.s |
|  | mean | 10.796 | 11.862 | 11.329 | 9.100 | 9.838 | 9.469 | 9.948 | 10.850 |  | CxSxP:1.102 |
| **Maize** |  |  |  |  |  |  |  |  |  |  |  |
| Grains | 0 | 6.830 | 6.259 | 6.543 | 6.778 | 6.429 | 6.604 | 6.804 | 6.344 | 6.574 | C: 2.383 C x S: 0.902 |
|  | A | 8.139 | 8.249 | 8.194 | 6.166 | 7.377 | 6.772 | 7.153 | 7.813 | 7.483 | S: n.s C x P: 0.942 |
|  | B | 13.752 | 10.722 | 12.237 | 12.244 | 12.608 | 12.426 | 12.998 | 11.665 | 12.331 | P. n.s S x P: n.s |
|  | mean | 9.574 | 8.410 | 8.992 | 8.396 | 8.805 | 8.601 | 8.985 | 8.607 |  | CxSxP: n.s |
| Stover | 0 | 6.164 | 6.401 | 6.283 | 5.736 | 7.216 | 6.476 | 5.950 | 6.809 | 6.379 | C: n.s C x S: n.s |
|  | A | 6.159 | 6.323 | 6.241 | 6.774 | 7.098 | 6.939 | 6.467 | 6.711 | 6.588 | S: n.s C x P: n.s |
|  | B | 5.639 | 6.389 | 6.014 | 6.208 | 6.587 | 6.398 | 5.924 | 6.488 | 6.206 | P. n.s S x P: n.s |
|  | mean | 5.987 | 6.371 | 8.179 | 6.239 | 6.967 | 6.603 | 6.113 | 6.669 |  | CxSxP: n.s |
| Whole plant | 0 | 12.994 | 12.660 | 12.827 | 12.514 | 13.645 | 13.079 | 12.754 | 13.153 | 12.953 | C: 3.019 C x S: n.s |
|  | A | 14.298 | 14.572 | 14.435 | 12.940 | 14.475 | 13.708 | 13.619 | 14.524 | 14.071 | S: n.s C x P: n.s 19 |
|  | B | 19.391 | 17.111 | 18.251 | 18.452 | 19.195 | 18.824 | 18.922 | 18.153 | 18.536 | P n.s S x P: n.s |
|  | mean | 15.561 | 14.781 | 15.171 | 14.635 | 15.772 | 15.204 | 15.098 | 15.276 |  | CxSxP: n.s |
| **Faba bean + maize (mg/both plants)** |  |  |  |  |  |  |  |  |  |  |  |
| Total uptake | 0 | 18.688 | 19.051 | 18.870 | 19.786 | 20.838 | 20.312 | 19.237 | 19.944 | 19.590 | C: 4.12 C x S: 0.802 |
|  | A | 22.748 | 23.409 | 23.078 | 21.050 | 24.231 | 22.641 | 21.898 | 23.820 | 22.859 | S: 0.463 C x P: n.s |
|  | B | 37.639 | 37.470 | 37.555 | 30.372 | 31.760 | 31.066 | 34.006 | 34.615 | 34.309 | P: 0.990 S x P: n.s |
|  | mean | 26.358 | 26.643 | 26.501 | 23.736 | 25.609 | 24.673 | 25.047 | 26.126 |  | CxSxP: n.s |

0 = no addition, A and B= 4 ton/fed of compost A and B, . respectively

$S_0$, $P_0$ = not added, $S_1$ and $P_1$ : 200 and 13.5 kg S and P/fed. respectively.

Data also showed that residual effect of compost B was significantly superior to unmanured treatment and that treated with compost A on increasing Zn-uptake by grains and whole maize plant. On the other hand, residual effects of S or P were found to be insignificant on Zn-uptake by maize plant.

Concerning the double interaction of these factors, statistical analyses revealed that residual effect of added S with compost A, and P with compost B caused negative significant effects on Zn-uptake by maize grains. On the contrary, addition of P raised compost A efficiency to be more significant than the control. From the other wise, the triple interaction effects were found to be insignificant on Zn-uptake.

The significant effects of the applied materials on micronutrients uptake by faba bean plant parts (as a direct effect) reported in the present study may be attributed to the interaction effect of compost, S and P. these results are in agreement with those of Alves *et al.*(1999) and Negm *et al.*(2002d and 2003).

## CONCLUSION

From the aforementioned discussion, it could be concluded that, the combined applications of the three studied materials increased significantly DM yields, and N, P, Fe, Mn and Zn uptake by the first crop compared with the treatment that received S and P only ($C_0S_1P_1$). However, their effects on N, P and Mn uptake extended to the successive crop.

## REFERENCES

Abd El-Ghaffar, A. S.(1978). The significance of organic materials to Egyptian agriculture and maintenance of soil productivity. FAO/STDA Workshop on Organic Materials and Soil Productivity in the Near East 9-18 Oct., 1978, Alex. Egypt.

Alves, W. L.; W. J. Melo and M. E. Ferreir (1999). Urban waste compost effects on sandy soil and sorghum plants. Revista Brasileria se Cie'ncia do Solo, 23(3):729-736(c.f. Field Crop Abs., 53(3)[1721]2000.

Arisha, H. M. and E.A.Abd El-bary (2000). Productivity and chemical content of spinach and pea after sulphur and sewage sludge application., Egypt. J. Soil Sci., 40(4):531-543.

Awad, A. M.; H. M. Ramadan and M.E. El-Fayoumy (1996). Effect of sulfur, phosphorus and nitrogen fertilizers on micronutrients availability uptake and wheat production on calcareous soils. Alex. J.Agric. Res. 41:311-327.

Awad, E. A. M.; M. M. Mostafa and A.M. Helmy(2000). Macro and micronutrient content of maize plant as affected by the application of some organic wastes and sulphur, Zagazig J. Agric. Res., 27(4): 1015-1029.

Black, C. A.; D..O. Evans; L. E. Ensunger; J. L. White; F. E. Clark, and R. C. Dineure (1965). " Methods of Soil Analysis" Part I and 2. Am. Soc. Agron. Inc. Ser.No.9 Madison, Wisc., USA.

Brunner, P.H. and H.R. Wasmer (1978). Methods of analysis of Sewage Sludge, Solid Wastes and Compost. Who International Reference Center for Wasts Disposal Ch 8600 Dubendorf, Suizerland.

Chapman, H. D. and P. F. Pratt(1961). Methods of Analysis for Soils, Plants and Waters, Division of Agric.Sci. Univ. of California, U.S.A.

El– Maghraby, S.E.; Farh A. Hashem and M.M.Wassif(1997). Profitability of using elemental sulphur after two years of application and its relation to organic manure under saline irrigation water. Egypt J. Soil Sci.37(4):511-523.

El-Fayoumy, M.E.(1996). Response of highly calcareous soils and faba bean crop to sulphur mixed with organic manure application. J. Agric. Sci., Mansoura Univ., 21(3):1183-1191.

El–Fayoumy, M.E.; H.M.Ramadan and S.A. El-Shanawany (2001). Calcareous soil amelioration as affected by different sources of soil amendments. J. Agric. Sci. Mansoura Univ., 25:3193-3207.

El-Raies, S. A; E.N.Gendy and R. A. Derar(1997). Responded lintil plant to phosphorus and sulphur application in alluvial soils. Egypt J. Soil Sci.37(1)111-124.

Fazal, M. and D.S. Sisodia (1989). Effect of sulphur and phosphorus on growth, nutrients and oil content in soybean and their residual effect on wheat crop. Soil and Fert. 1990 53,12,14928.

Genaidy, S.(1994). Evaluation of organic manure and phosphorus fertilization of wheat crop in salt-affected soils. Zagazig J. Agric. Res., 21:573-582.

Hashem, F.A.; S.E.-El-Maghraby and M.M. Wassif (1997). Efficiency of organic manure and residual sulphur effect under saline irrigation water and calcareous soil conditions. Egypt J. Soil Sci. 37(4)451-465.

Negm, M. A.; El-Sayed, M.H and A. S. Ahmed (2001). Effect of treated compost and sulphur application to calcareous soil on soil properties and cereal production. the 1st International Conf. on Biotechnology Application for the Arid Regions, 9-11 April 2001, Kuwait Inst. Sci. Res., AlKuwait, Abs. No. 30.

Negm, M.A.; R. G. Kerlous; L.A. Hussein and A.H.El-Sayed.(2002a). Effect of farmyard manure and potassium sulphate application on maize in a calcareous soil. Egypt J. Soil Sci., 42(3)435-447.

Negm, M.A.; H. El-Zaher; M.M. Abd Elghani and M.M. Salib (2002b). Effect of commercial compost (Biotreasur) and sulphur added to a calcareous soil on: 1- Soil properties and fertility. Menufyia J. Applic. Res. 36(3):369-379.

Negm, M.A.; H.El-Zaher; M.S.Awaad and M.H. El-Sayed (2002c). Effect of a commercial compost Biotreasur and sulpher added to a highly calcareous soil on: II-Cereal productivity and nutrient uptake. Minufiya J. Agric. Res. 27(2):381-390.

Negm, M.A.; M.H.El-Sayed; A.S.Ahmad and M.M.Abd Elghani (2002d). Wheat and sorghum response to biocomposit compost and sulphur added to a calcareous soil. Zagazig J. Agric. Res., 29(6)1973-1985.

Negm, M. A.; M., M. Salib and H. El-Zaher (2003). A field trail on biocomposite and sulphur applications for improving the productivity of soil calcareous in nature. Fayoum J. Agric. Res&Dev.,17(1):77-89

Ramadan, H.M.; M.E.El-Fayoumy and A.M.Awad (1996). Effect of sulfur, phosphorus and nitrogen fertilizers on macronutrients availability, uptake and wheat production on calcareous soils. J.Agric. Mansoura Univ.(4)1589-1606.

Rehan, M.G.; A.H.El-Sayed; M.M. Hassan and M.A.Negm (2004). Direct and residual effects of mixing the added compost to a calcareous soil with sulphur and phosphorus. 1- on crop yields and some soil properties. J. Agric. Sci. Mansoura Univ., 29(3)1603-1614.

Saber, M.S.M. and M.O Kabesh (1990). Utilization of biofertilizers in field crop production.II- A comparison study on the effect of biofertilization or sulphur application on yield and nutrient uptake by lentil plants.

Sarkadi J. (1995). Utilization of the nutrient contents of organic manure and mineral fertilizers in long-term experiments II P. Balance. Agrokemia-es Talajtan, 44(1-2),5.

Snedecor, G.W. and W.G. Cochran (1971). Statistical Method 6$^{th}$ Ed., Iowa. State Univ. Pres. Ames

Sommers, L.B. and D.W.Nelson (1972). Determination of total phosphorus in soil; A rapid perchloric acid digestion procedure. Soil Sci. Soc. Amer. Proc., 36:902-904.

Wassif, M.M.; A. El-Shall; I.H.El-Bagouri and M.Hilal(1988). Effects of sulphur, phosphorus and organic manure on yield and nutrient content of fodder beet under the condition of saline irrigation water. Desert Inst. Bull., A.R.E., 37(1):131-140.

# التأثير المباشر والمتبقى لخلط المكمور المضاف للأرض الجيريه بالكبريت والفوسفور على الوزن الجاف لمحصولين متعاقبين وامتصاصهما بعض العناصر الغذائية

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**معهد بحوث الاراضى والمياه والبيئه- مركز البحوث الزراعية-الجيزه- مصر**

فى تجربة حقليه بمزرعه محطة البحوث الزراعية بالنوباريه خلال موسمين متعاقبين (٢٠٠١ – ٢٠٠٢) على أرض جيريه ذات قوام طميى طينى رملى لدراسه- التأثير المباشر والمتبقى لكل من المكمور والكبريت والفوسفور على الوزن الجاف لبذور وقش نباتات الفول البلدى وحبوب وحطب الذره الشاميه وكذلك الكمية الممتصة لبعض العناصر الغذائية بواسطه النباتات المستخدمة فى الدراسة. نتيجة اضافة نوعين من المكمور (أ ، ب) بمعدل (٤طن/فدان) بصوره منفرده أو مشتركه مع عنصر الكبريت (بمعدل ٢٠٠ كجم كب/فدان) أو الفوسفور (بمعدل ١٣,٥ كجم فو/فدان) أو كليهما.

**ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:-**

١- اضافة المكمور أ او ب فى صورة منفرده أو مشتركة مع الكبريت والفوسفور أدت الى زياده معنويه فى الوزن الجاف لبذور وقش نباتات الفول البدى كدليل على وضوح الاثر المباشر للمواد المضافة قياسا بمعاملة المقارنه وكذلك أعطى حبوب وحطب الذره الشاميه نفس الاتجاه كدليل على وجود الاثر المتبقى للمواد المستخدمة ولكن بدرجه غير معنويه.

٢- أظهرت النتائج عند اضافه المكمور مع الكبريت والفوسفور معا زياده فى الوزن الجاف لبذور وقش نبات الفول البلدى مقارنه بالمعاملة المضاف اليها المكمور مع الكبريت وأيضا تلك المضاف اليها المكمور مع الفوسفور ولكن هذه الزياده غير معنويه.

٣- أدت اضافه المكمور (أ أو ب) فى صوره منفرده أو مشتركه مع كل من الكبريت والفوسفور الى زياده معنويه فى امتصاص النتروجين، الفوسفور، الحديد، المنجنيز والزنك فى كل من بذور وقش الفول البلدى وكذلك حبوب وحطب الذره الشامية عدا الزنك فى حطب الأخير.

٤- وجد تفوق معنوى للمكمور أ على المكمور ب فيما يتعلق بالوزن الجاف لقش للفول البلدى وكامل نباته وكذلك امتصاص النتروجين والحديد بينما تفوق المكمور ب على أ فى امتصاص البوتاسيوم والمنجنيز والزنك.

٥- لم تظهر اختلافات معنوية بين المكمور أ ، ب فى امتصاص عنصر الفوسفور بواسطه الاجزاء المختلفة للمحصولين تحت الدراسه.

ومن ثم يمكن التوصيه بصفه عامه باضافه ٤ طن مكمور مع ٢٠٠ كجم كبريت معدنى و ١٣,٥ كجم فوسفور/فدان للحصول على تأثير ايجابى مباشر للمحصول المنزرع فى نفس موسم الاضافة بينما اضافة جزء معين (يحدد بمزيد من التجارب)من هذه المعدلات قبل بداية الموسم الثانى ربما يكون أكثر فائدة من التأثير المتبقى الحالى.