Improvement And Correction Soils Of Rice Farms In Guilan Province Using Slag Of Steel Plant

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***Abstract*—Steel slag or converter is a synthetic and lateral product in the iron and steel industry that produces impurities in iron ore when iron is removed from iron smelting furnaces. The slag used in this study contains 52.85% CaO and 2.22% Mgo, respectively.In order to investigate the possibility of using LD slag as a calcareous material, a test was carried out using Gilan agricultural soil. The study included two phases. The first phase of the incubation test and the second phase were a greenhouse study. Soil samples were taken from a depth of 0.30 cm from the rice field surface. The treatments in the first phase consisted of 0.5 1 2 4 and 8% converter per milligram of soil.Soil moisture in the field capacity was kept constant for 2 months. At 1, 10, 30, and 60 days from samples, sub-samples were taken to examine the changes in pH and EC, and the concentration of Fe Mn p and k can be extracted by DTPA -AB. In the next step, according to the results of the incubation method, the greenhouse experiments were determined and applied. In a pot experiment, corn was used as a control plant. After harvesting, after 50 days, dry weight and phosphorous, potassium, iron and manganese adsorption were determined. The results showed that the soil pH increased with increasing slag ratio. The slag increased the amount of p and Mn extractable to DTPA -AB proportional to the amount applied. The effect of slag on the amount of iron varies depending on the initial pH of the soil. As the pH of the soil increased to 8.5-7.5, the iron concentration decreased, and then the iron content increased again with increasing pH of the soil.DTPA -AB extractable potassium slag, especially in highly acidic soils. Pot experiment results showed that the dry weight of the plant increased by 0.5 1 and 2 percent slag. Application of slag increased phosphorus uptake in rice soil. The use of slag increased the absorption of iron and manganese. Potassium adsorption also increased in rice paddy soil. According to the results, the converter slag is suitable for acid soils.**

Keywords—Keywords: Acid Soils - Slag - Modifier - LD Converter

Introduction :

Due to the problems with acid soils, there is a need to correct them. One of the simple methods for the proper use of acid soils is the proper selection of plants. Cochine has adequate soil acidity. This plant adaptation and soil pH can only be answered in some cases because the plant itself can not increase the pH of the soil. Therefore, one of the solutions is the acidification of alkali and the increase of soil pH using calcareous materials. (19) Lime to neutralize soil acidity is one of the common methods for managing acid soils. It seems that the treatment is essential for the effective production of moisture in agriculture, which leads to improved yields. (6)

The use of common calcareous materials to modify acid soils is relatively expensive. Consequently, various materials have been used to correct acidic soils (15, 19, 24, and 2), the most important of which is the slag of the steelmaking industry. For a ton of steel, about 150 kg of slag is produced. (21) Each year, more than 50 million kg of slag is produced in Gilan, which contains valuable materials and compounds. In recent years, the use of slag as a calcareous material in acid soils has become very important. Only in Germany, 20% of the total steel slag is used as fertilizer or soil reformer in agriculture. (28) Chow is used in the production of steel from lime, so slag has a (PH) mucilage. (9). The high concentrations of calcium and mercury LD converting the slag into a calcareous substance. (21) Therefore, the use of slag as a fertilizer and fertilizer in acidic soils has positive results. Agentwinbo and Hankaran (1996) concluded that slag increased the pH and absorbed phosphorus and decreased aluminum, as well as increased calcium and / or thawing and the amount of dry matter The plant. In general, the use of slag improves the absorption of nutrients by plants.

A large amount of slag formed by the Bessemer method is mixed with LD slag, and the Thomas lime is used in agriculture. In slabs, slag consumption has increased the yield of agricultural products compared with limestone. (12) Christeen and Hacker (1996) studied the effect of slag and limestone on organic acidic soils in Norway. They realized that the neutralizing power of both products was the same in neutralizing (PH) the soil. In addition to the keratin characteristic, slag also has a number of elements needed for plant growth. (Table 1) The purpose of this study was to investigate the possibility of using converter converter slag to improve acidic soils of Gilan agricultural land.

Materials and Methods:

The results of the chemical analysis of the converter slag (LD) used in this study are shown in Table 1. The slag contains 52.85% calcium oxide and 2.22% magnesium oxide. Meanwhile, the slag contains large amounts of iron and phosphorus iron, and silicon that can increase production in some agricultural products. Sampling of agricultural land was carried out in Gilan province and at a depth of 0-30 cm. Soil (PH) of soil in rice fields was 7.6.

1-Slag
2-Converter
3 - L and D words The first two letters of the name of the two villages in Austria, Linz and Donauwitz, have been carried out in the early stages of steel making by the oxygen converter method.

4-Besmer

Table (1) Results of chemical analysis of converter LD slag

CaO	**52.85**
Tfe	**16.82**
SiO	**8.93**
FeO	**7.88**
P2O5	**4.75**
MnO	**4.46**
V2O5	**2.33**
MgO	**2.22**
Al2O5	**0.79**
S	**0.18**
Na2O	**0.075**
ZnO	**0.057**
K2O	**0.032**

After sampling, the soil samples were transferred to the laboratory and air dried, then they were pierced with a wooden hammer and passed through a 2 mm sieve. Each sample obtained was divided into two parts. The first part was used for physical and chemical analysis, and the second part was used for incubation experiments. To test the greenhouse, soil samples were passed through a 6 mm mesh. Table (2) shows some of the physical and chemical properties of the studied soils.

Table (2) Some physical and chemical properties of soil samples studied

Soil	number 1	number 2	number 3
Texture	**Loom**	**Sandy looney**	**Clay loam**
Classification	**Hapludalf**	**Hapludalf**	**Epiaqualf**
Total saturation PH	**4.1**	**5.5**	**6.7**
Total Nitrogen	**0.27**	**0.07**	**0.03**
Phosphorus (mg / kg)	**10.4**	**12.4**	**2.1**
Manganese (mg / kg)	**27.8**	**14.2**	**14.2**
Potassium (mg / kg)	**197**	**114**	**125**
Iron (mg / kg)	**302**	**100**	**465**

In this study, slag was mixed at 0, 0.5, 1, 2, 4 and 8 percent levels in 3 replicates in a randomized complete block design with 500 grams of soil. In this research, these levels are 0 S, 0.5 S, 1 S, 2 S, 4 S and 8 S, respectively. The treated samples were transferred to plastic cans and their moisture content was kept at farm capacity. Then the cans were closed and on the lid of each can, three holes with a diameter of about 1 mm were created for air exchange. During the test (2 months), the moisture content of the soil samples was kept constant with weighing of the cans. Samples were harvested 24 hours a day, 10 days a month and two months after the start of the experiment. These samples, after drying in air (PH), and electrical conductivity in extract of 2.5: 1 soil to water and concentration of phosphorus, potassium, iron, manganese and zinc with AB-DTPA extraction (25) and then phosphorus concentration by method Potassium phosphate molybdate was determined by flash flame measurements, manganese iron and zinc by atomic absorption method. (3) After obtaining the results of incubation experiments and according to the results, the experimental treatments for pot experiment were determined.

The treatments were applied on 3 kg samples from each soil and from single maize cultivar, crosses 647 as a control plant. 50 days after emergence of the plants, the plants were cut to a height of 1 cm above the surface of the soil, and after being washed with 0.1 N normal chloride and distilled water was heated to 65 ° C for 72 hours at an oven to reach the weight Fixed dry. After determining the dry weight of the plant in each pot, dried specimens were dried and kept for chemical analysis. Also, the soil was cultured after harvesting and drying, and then after drying in air and passing through a 2 mm sieve, chemical analyzes were used. In vegetative samples, in addition to drying of air in each pot, the concentrations of iron phosphorus manganese and potassium in the plant were measured. Also, the amount of absorption of each element in each pot was calculated using the obtained concentrations and dry yield of the plant. In soil samples, both pH and EC (in a 2.5: 1 extract to water) were determined and the amount of iron and manganese extracted by AB-DTPA solution was determined. Data were analyzed by SPS and MSTATC software. The results were analyzed in four sampling times in each incubation and the results of the discussion and the average results of the treatments were discussed and concluded.

Discussion and results

1-stage incubation

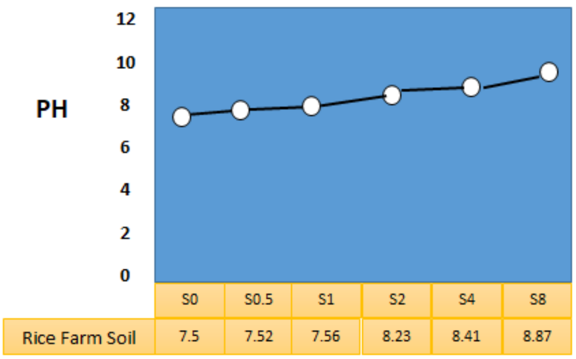
The reaction (PH) in Table (3) shows the results of various levels of slag and storage time on the pH of the soils. Analysis of variance showed that the effect of treatments on pH of acid soils is significant at 1% probability level.
(Figure 1) increased by 0.5% to 8% (pH) of slag by adding slag. Pinto et al. (1995) concluded that soil pH in the Marine Region was 5.3 to 6.4 in the province of Basque in northern Spain, using LD slag containing 29% calcium and 5% magnesium at 7.5 tonnes per hectare. 5.7 to 6.5. Oyia et al. (1990) also concluded that the use of 5.3 grams of long-fired slag in each plant increased soil pH from 4.7 to 5.8. There is no significant difference in rice levels in 0.5 and 1% slag of rice as compared with control, which is probably due to the high clay content (clay loam clay) in this soil. Therefore, pH correction of acidic soils by slag is one of the main advantages of the artificial and lateral products. Similar results have been reported by Peugeot other hackers.
1-Derio
2-Abadiano

Table 3: Analysis of variance related to the effect of treatments and storage time on PH, electrical conductivity and iron content of manganese and potassium (mg / kg) extractable by AB-DTPA in rice field soil

Sources Change	Degrees of freedom	Reaction	Iron	Phosphorus	potassium	Manganese	**Electrical conductivity**
Treatment	6	**17.7	58911**	**1765	**345	**33422	****0.083**
Time	3	**0.47	*1206	**109	**522	**861	****0.19**
Interaction	18	**0.29	**2255	**85	88 ns	**1006	****0.015**
Treatment * Error Time	56	0.06	113	4.7	70.5	13.3	**0.001**

** at a probability level of 1% is significant. ns not meaningful

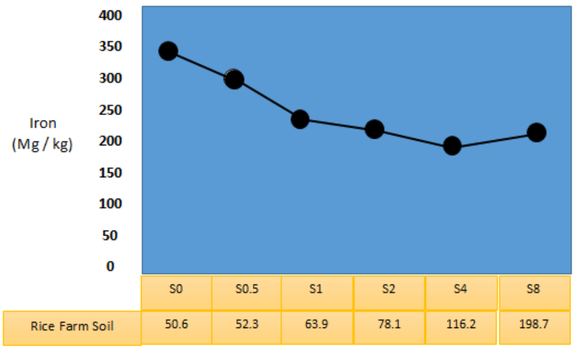
Chart (1) The average effect of treatments on pH of soils



Iron:
Analysis of variance of data shows that the effect of treatments on iron extractable to AB - DTPA is significant at 1% probability level. (Table 3) shows (2) the effect of treatments on absorbable iron in these soils. The amount of iron absorbed decreases by increasing the amount of sulfur to 4%, and the amount of iron increases in S8. Due to the decrease of iron concentration in S 0.5 S 1 S 2 and S 4 treatments, the pH of the soil is increased and the solubility of iron is close to the lowest solubility of iron oxide III (PH range 8.5 - 7.5). With an increase in pH above 8.5 at 8% level, the concentration of iron III anionic species, such as Fe (OH), predominates in soil and iron concentration increases again. (13) In the soil of rice, the dependence of iron is also found on soil pH changes. Considering the near-neutral ph in this soil, it is noted that by increasing the level of slag, from 1 to 16 percent of the amount of recoverable iron was added. Figure 1 shows that using 2% slag or more ([PH]

The soil dominates and the iron concentration increases again. (13) In the soil of rice farm, the dependence of iron is absorbed by soil changes (ph). Due to the near-neutral pH in this soil, it is noted that by increasing the level of slag from 1 to 8 percent, the amount of iron is also absorbed. As shown in Chart (1), applying 2% or more of soil pH slag exceeded 8.5 and increasing the concentration of anionic species produced by iron II hydrolysis also increases the soil's absorbable iron content.

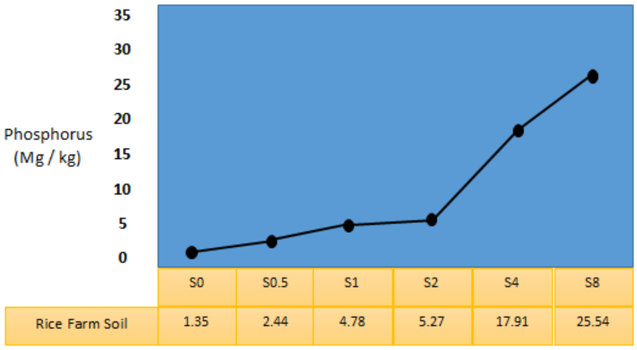
Chart (2) The average effect of treatments on iron (mg / kg) extractable to AB-DTPA in soils



According to the Duncan test, for each soil, data in a single letter is not significant at 1% level.
Phosphorus:
The effect of slag on phosphorus is shown in Fig. 3. Effect of treatments on abatacept with AB-DTPA in soils at 1% level. (Table 3). With regard to the results of this research, it can be stated that one of the most important potential of slag in acid soils is increasing the amount of phosphorus available in the soil due to the high amount of phosphorus in the slag Not expecting Basak and Saha (1995) observed during an incubation experiment that the effect of slag on

the amount of phosphorus to be extracted by Barry II method was much higher than that of Missouri rock phosphate. The slag also contains a lot of silica that can release the stabilized phosphorus from the soil. Christine and Arstad (1996) observed that the highest concentration of P was obtained using 14.4 tons per hectare of slag. Surabamanian et al. (1990) also found that using silicate calcium (slag), the application of these materials at a level of 500 mg / kg of silica increased the amount of phosphorus available in the soil.

Chart (3) The effect of treatments on phosphorus (mg / kg) extractable by AB-DTPA in soils



According to the results, the use of slag in soil of rice field increased the soil available phosphorus. The use of slag especially in 4 and 8% resulted in a significant increase in soil P available. The effect of the converter slag on the concentration of phosphorus extractable with AB-DTPA in soil is not due to the presence of phosphorus in its composition, but the increase of PH and the release of phosphorus from iron and aluminum phosphate as well as the replacement of silica in the exchange sites instead of phosphate increases phosphate The concentration of phosphorus is soluble (27). In general, the concentration of available phosphorus in addition to the phosphorus in its composition also depends to a large extent on the pH of the soil, and PH also has an impact on the microbial activity on the solubility of various phosphorus compounds, and in the alkali PH, phosphorus is calcium phosphate Insoluble sediment.

Manganese potassium:

The effect of treatments on manganese and potassium-extractable by AB-DTPA in rats was significant at 1% level. (Table 3). The important point about potassium is that by increasing the amount of slag in soils, the amount of potassium that is extractable can be reduced. (Table 5). This decrease in irrigated rice fields is not significant. The cause of soil potassium loss is its stabilization. The increase in soil pH (due to the addition of slag) has the effect of removing the iron and aluminum hydroxyl polymers in the interlayer of clay and thus increasing potassium fixation. Another important factor in stabilizing potassium is the formation of potassium insoluble compounds, especially potassium aluminosilicates (high pH) (by adding high levels of slag) [5].

1-Bray

Table 4. Effect of treatments on the amount of manganese (mg / kg) extracted by AB-DTPA in soils

Treatment / Soil	S0	S0.5	S1	S2	S4	**S8**
rice farm	13.9 e	13.9 e	16.8 e	30.5 d	53.7 c	**110.7 b**

A.

Table 5. The average effect of treatments on the amount of potassium (mg / kg) extracted by AB-DTPA in soils

Treatment / Soil	S0	S0.5	S1	S2	S4	**S8**
rice farm	91.0 abc	98.8 a	89.4 abc	94.5 ab	89.4 abc	**86.0 bc**

B.

Table 6. The average effect of treatments on the electrical conductivity (ds / m) extracted by AB-DTPA in soils

Treatment / Soil	S0	S0.5	S1	S2	S4	**S8**
rice farm	0.40 c	0.44 bc	0.43 bc	0.44 bc	0.45 bc	**0.35 db**

The results also showed that, with increasing levels of slag, the concentration of manganese has increased (Table 4), which results in a concentration of 46.4% MnO in the slag. Khan (1992) concluded using slag as a soil modifier. The concentration of Manganese in the treated soil has increased.

Electrical conductivity

The effect of treatments on electrical conductivity in soils is significant at 1% probability level (Table 3). In all samples, slag application has increased the electrical conductivity of the soil (Table 6). This increase in high levels of slag, the S8 treatment, is more noticeable. However, because slag is a low-solubility compound, its effect on electrical conductivity is not significant at all levels of consumption, and has no susceptible effect on EC soil, except for plants that are highly sensitive to salinity and also at high levels of slag consumption. Does not affect.

Electrical conductivity

2-stage greenhouse plant performance

Results of analysis of variance of data (Table 5) show the effect of treatments on plant dry yield in soils at a probability level of 1%. Chart (4) shows the effect of treatments on dry weight of the plant on tea soil. Significant increase in dry weight of plants was observed in 1S and 2S treatments compared to control. Increasing yield in 1S and 2S treatments was 1.35 and 1.42 times, respectively, in dry matter. Increasing the yield is probably due to the correction of soil pH to the desired level due to the use of slag in these treatments. Also, increasing the soil fertility level especially phosphorus, calcium, magnesium, silicon, iron and manganese has increased plant yield. Oyia et al. (1990) in Okinawa, Japan, using high-frying slag in proportions of 5.3 and 16.5 grams per pot in an acidic soil with a pH of 4.7, considered that Rhodes grass performance was significantly increased in treatment of 5.3 g slag in the pot Is. Fritz et al. (1989) found in a field experiment that the average plant yield increased only when using superphosphates and slag compared to superphosphate. Pinto et al. (1995) concluded that the dry matter of the plant has increased due to the use of slag in the northern spain of Derry. The response to slag usage in the second year was higher than the first one. Dry weight of plant in S4 treatment with control was not significantly different. Reducing the function of this treatment compared to other treatments is probably due to increased soil pH and nutrient absorption imbalance. Agentwinbo et al. (1996) concluded that the use of game slag in the amounts of 250 and 500 mg of calcium per kg of acidic soil increased the yield of plant dry matter by 1.5 times. However, in the amounts of 1000 and 2,000 mg of calcium per kg of soil, the performance was reduced and did not differ with the control.

Table 7 - Analysis of variance related to the effect of treatments and their storage time on dry weight of the plant and the absorption of iron phosphorus Mn and potassium (mg per pot) by the plant in rice field soils

Sources Change	Degrees of freedom	Plant dry weight	Iron	Phosphorus	potassium	**Manganese**
Treatment	**3**	****5.75**	****0.156**	****46.5**	****46.5**	****0.175**
Error	**8**	**0.069**	**0.0029**	**35.5**	**1.11**	**0.0069**

Chart 4 - Effect of treatments on dry weight of the plant in rice field soil

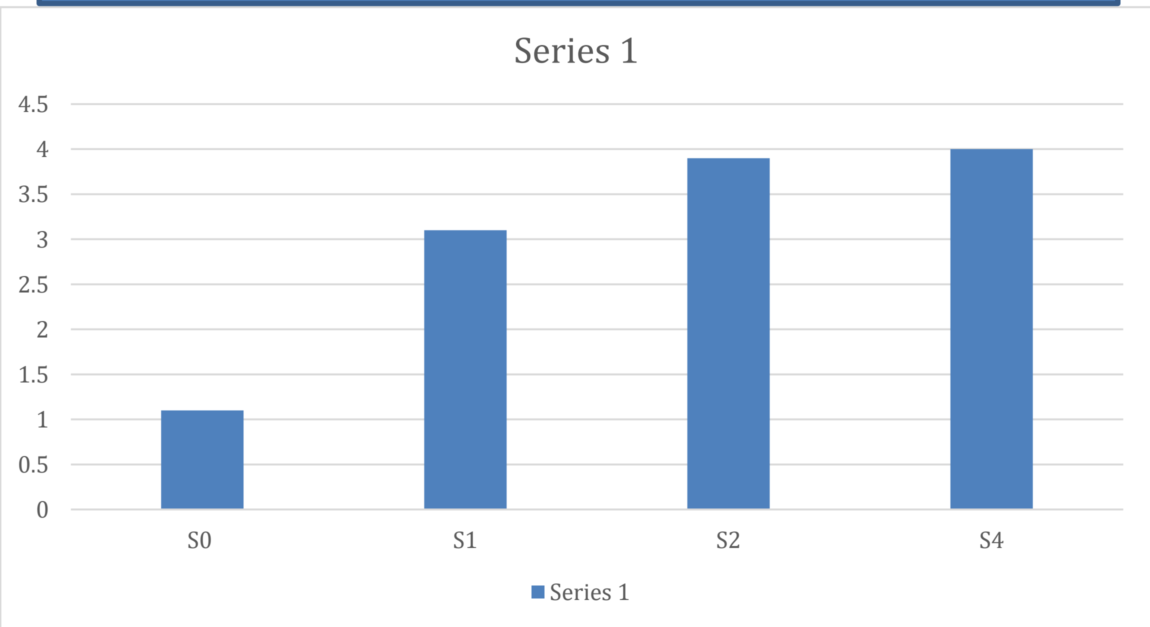


Chart (5) shows the effect of treatments on dry weight of the plant in rice field soil. In this soil, a significant increase in plant yield is observed in the S0.5 and S1 treatments compared to the control. S2 treatment showed a significant increase compared to control, but showed a significant decrease compared to other treatments of other slags. In southern Nigeria, the use of game slag in amounts of 500 and 1000 mg / kg of acidic soil, dry weight of the plant was significantly higher than that of the control (15). Kristen and Arstad (1996) concluded that the application of 14.4 tons per hectare overhead of the converter was the highest dry product of the plant (Grass).

They suggested increasing the yield by increasing the phosphorus, iron, manganese, silicon and other nutrients present in the slag. Increasing the performance of this study can be due to the above reasons.

Absorbing phosphorus

The concentration of nutrients in the plant in some cases, including the effect of dilution, may not indicate the actual effect of treatments on the plant. In these cases, considering the absorption of these elements by the plant can be a more appropriate factor for assessing the effect of treatments. The absorption of each element by the plant is determined by two factors: the concentration of the element in the plant and the dry weight of the plant, which is the product of the concentration of the element in the dry matter of the plant. In the present study, the dry weight of the plants on each pot is considered as the dry yield of the plant and is reported in grams per pot.

Table 7 shows the analysis of variance related to the effect of treatments on the phosphorus uptake by the plant in soils at a probability level of 1%. Casanova et al. (1993) in Bolivia, Venezuela, concluded that the use of 200 kg / ha The Monfersco Phosphate rock with 600 kg / ha game overhead has increased phosphorus absorption from 0.1% in the control portion to 0.2% in the treated crop. Basak et al. (1995) investigated the effects of different activities on phosphorus uptake by wheat plant in acidic soils of West Bengal in a pot experiment. They found that using 350 kg per hectare, the most commonly used superphosphate source, along with slag, is the highest phosphorus intake. Absorption of phosphorus by plant was not significant in S4 with control.

Chart (5) Effect of treatments on phosphorus uptake in rice field soil

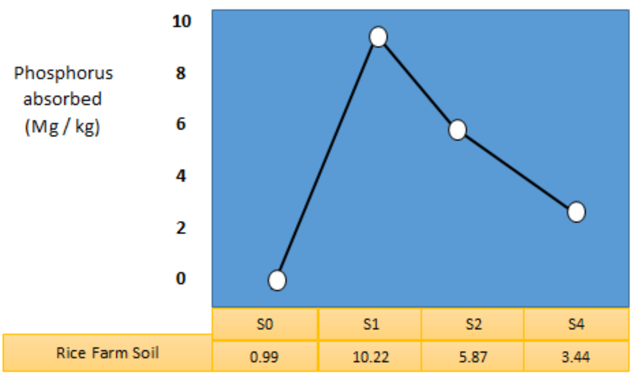


Chart (5) shows the phosphorus absorption by the plant in rice field soil. Phosphorus adsorption in S0.5 and S1 treatments show a significant increase compared to the control. In S2, phosphorus absorption was significantly higher than that of control, but it decreased significantly with S0.5 and S1 treatments. Agentwinbo et al. (15) in southern Nigeria found that the use of acrylic acid in an acidic soil of 250 and 500 mg calcium per kg of soil significantly increased the phosphorus absorption of the plant, but in the amounts of 1000 and 2,000 mg calcium per kg of soil , Phosphorus absorption decreased by plant, but there was still a significant increase compared to control treatment.

Iron absorption

Table 7 shows the results of analysis of variance of data for the effect of treatments on iron uptake by the plant in soils at a one-percent probability level. In the incubation stage, it was observed that the use of slag at the above levels leads to a decrease in iron concentration in the soil, which can lead to less iron absorption and lower concentrations in the plant. In Sarcunan et al. (1993) studies, it was also observed that the use of ferrochrome overhead in an acid ethanol equivalent to 1.25-2 times the calcareous requirement decreased the concentration of iron in rice.

Table (8) shows the effect of treatments on iron absorption by the plant in rice field soil. Significant increase in iron absorption by the plant was observed in TIMAR 5.0S compared to control. This increase is due to the plant's dry weight gain. Significant increase in iron absorption in Tymre 1S compared to control due to the higher yield of this treatment and high concentrations of iron in the plant. In the incubation stage, it was observed that the use of slag in this soil increased the soil absorption of iron. The absorption of iron by the plant in the S1 treatment is more than indicative. Iron absorption under this treatment shows a significant decrease compared to S1. This is due to reduced yield and reduced iron concentration (146.6 ppm in 2S treatment compared to 169.3 mg / kg in 1S treatment) in 2S treated plant compared to 1S treatment. Reduction of iron concentration may be due to Iron deposits in the root and occupy active iron adsorption sites.

Table 8 Effect of iron and manganese and potassium intake in rice field soil

Food ingredient / Treatment	Iron (Mg in the pot)	Manganese (Mg in the pot)	potassium (Mg in the pot)
S0	**0.15 c**	**0.17 b**	**40.9 c**
S0.5	**0.50 b**	**0.60 a**	**74.3 ab**
S1	**0.70 a**	**0.72 a**	**79.1 a**
S2	**0.16 b**	**0.57 a**	**65.3 b**

Absorb manganese

Results of analysis of variance of data (5) show the effect of treatments on plant manganese absorption in soils at a probability level of 1%. There is a significant increase in manganese absorption by the plant in S1 and S2 treatments than in the control (Tables 7 and 8). This increase was due to increased yield and Mn concentration in plant (407 and 386) parts per million in S2 and S1 treatments, respectively, compared to 353 mg / kg in control treatment). In incubation, it was observed that slag increased the soil absorbance of manganese. The results of soil pouring analysis also confirm this. Therefore, increasing the amount of manganese that can be absorbed in soil can be a factor in increasing manganese absorption by the plant and increasing the manganese concentration in the plant. S4 treatment with control has no significant difference. In soil of rice, a significant increase in manganese uptake by plant was observed in slag treatments compared to control. In these treatments, yield and megane concentration (except Mn concentration in S0.5) were significantly increased compared to control. There is no significant difference between slag treatments in terms of manganese uptake by plant.

Potassium adsorption

Analysis of variance of data (5) shows the effect of treatments on potassium uptake by plant in soils at a probability level of 1%. Kristen and Arstad (1996) concluded that the use of converter slag in the amount of 3.6, 7.2 and 14.4 tons per hectare reduced the concentration of potassium from 1.80% in the control treatment to 1.67, 1.65 and 1.63% in the above mentioned treatments. In rice field, there is a significant increase in potassium uptake by plant in slag treatments than in control (Table 8). This increase is due to the high yield of the plant in these treatments. Kahn et al. (1992) concluded that the application of 40 tons per hectare of slag increased the potassium uptake by rice.

Decomposing the soil of the pots after plant harvest

Data analysis of variance showed the effect of treatments on pH, electrical conductivity and iron and manganese residue (AB-DTPA detergent after plant harvest at a probability level of 1%), which resulted in a significant increase (pH) of soil The pots have been adapted to the amount of consumption, and the effect of slag on the soil pH (pH) was lower than the incubation stage, due to plant growth, root respiration, and root propagation in acid permeability, resulting in a decrease in pH (pH). Soils of slag cause EC soil to increase, but this increase in rice field soil is significant in 1S and 2S treatments compared to control. The effects of the treatments on the concentration of extractable iron and manganese are consistent with the results of the incubation stage experiments and the same trend.

Final result:

1- The results of the research showed that the pH of the soil increases with increasing slag ratio.

2. The slag increased the amount of p and Mn extractable to DTPA -AB proportional to the amount applied.

3- The effect of slag on the amount of iron depending on the initial pH of the soil. So that the pH of the soil decreased in the range of 8.5 to 7.5 from the iron concentration, and then the iron content increased again with increasing pH of the soil.

4. DTPA -AB extractable potassium slag, especially in highly acidic soils.

5. Pot experiment results showed that the dry weight of the plant increased by 0.5 1 and 2 percent slag.

6. Application of slag increased phosphorous iron, manganese and potassium adsorption in rice soil.

7- According to the results, it seems that the use of converter slag is suitable for acid soils.

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