RESEARCH REGARDING THE INFLUENCE OF LF SLAG ON CHROMIC LUVISOL REACTION AND WHEAT YIELD IN THE EXPERIMENTAL FIELD FROM MOARA DOMNEASCĂ

MIHALACHE M.[1], ILIE L.[1], MARIN D.I.[1], ILDIKO ANGER[2]
[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest
[2]National R&D Institute for Nonferrous and Rare Metals of Pantelimon

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ABSTRACT

Lately,changing soil reaction as a consequence of culture technologies necessary measures to amend and improve them. The areas of soils with high acidity in Romania are very large and their improvement is expensive and lengthy. High acidity is due on the one hand, soil genesis and secondly the use of technologies and fertilizers which have decreased reaction from year to year. The research wereconducted in 2014 in the experimental field at Moara Domnească by using LF slag from metallurgy onthe chromic luvisol, demonstrated that it can be used as an amendment to correct acidic soil reaction. Increasing soil reaction resulted a better use of nutrients from soil and a significant increase in wheat yield. The highest yield were registered by the application rates of more than 3 t/ha of slag together with nitrogen (100 kg/ha).

INTRODUCTION

Changing global ecosystems, due to the consumption and production showing how important is the process of rethinking the use of natural resources by the economy and society.

Utilization of industrial waste materials in the improvement of problematic soils is a cost efficient and also environmental friendly method in the sense that it helps in reducing disposal problems caused by the various industrial wastes.

The surface of soil suffers an acidification process especially under the-conditions without liming, soil pH values less than 5.5 ensure conditions for strong solubilization of pollutants and their translocation into plants.

Each year, about 45 million tonnes of ferrous slag (iron and steel slag) is generated in Europe (European Slag Association).

The steel industry produces not only metal, but also a by-products which has been successfully used in many construction or agriculture applications.

The awareness of environmental considerations and more recently the concept of sustainable development as well as the need for recycling of by-products for economic and environmental reasons has led to rapid development of slag utilization.

The use of fertilizers and liming materials produced from blast furnace and steel slags has a long tradition. For example Thomasphosphate had been used for more than hundred years.

Silicate lime fertilisers (blast furnace lime and converter lime) are approved fertilizers in Germany since more than 60 and 30 years, respectively. They contain elements with useful properties for plant nutrition and soil quality.

Calcium and magnesium in slag have a better solubility than that of magnesium carbonate in natural limestone and dolomite. Both elements serve as plant nutrients and stabilizers for soil aggregates and their basicity increasesor maintain soil pH.

The solubility of silicate from slag is often higher than from many other silicate containing soil improvers or rock powders. Silicate has beneficial effects on plant health, phosphate availability and soil structure. The content of trace elements like manganese, copper, zinc, boron or cobalt in slag satisfies both plant and animal demands.

Blast furnace lime has a mild effect on soil pH. Therefore, it is especially recommended for use on humus, sandy and peat soils. In addition, the high silicate and magnesium content which is readily available to plants promotes yields and plant qualities.

Converter lime from basic oxygen furnace slag as well as from ladle slag from the production of non-alloyed steel is suitable for all kinds of soils. It has a high neutralising value with prompt and sustainable effects on soil pH. The soluble silicate content and its reactivity increase the phosphate mobility in the soil and improve the efficiency of phosphate fertilisation.

Careful selection and processing of appropriate slag qualities ensures an effective activity in the soil.

The basicity of the calcium and magnesium compounds in the slags improves soil pH. Both elements also serve as plant nutrients and stabilisers for soil aggregates. Magnesium in slags especially in blast furnace slag has a better solubility than that ofmagnesium carbonate in limestone and dolo-mite. Silicate has beneficial effects on plant health, phosphate availability and soil structure. The content of trace elements like manganese, copper, zinc, boron or cobalt satisfies both plant and animal demands (Rex M., 2010).

Mohammadi T. concluded that these materials used on the soil acid increased soil pH and AB-DTPA extractable P more than paper mill sludge (PMS) and increased Mn proportional to the slag application rate, while PMS decreased it.

MATERIAL AND METHOD

The research was conducted in 2014 in the experimental field of the Faculty of Agriculture from Moara Domnească on chromic luvisol (Fig. 1). Chromic luvisol is characterized in the surface horizon (Ao) the following properties: humus content - 2.4%, clay-loamy texture, soil reaction is between5.2 and 5.4, the base saturation degree - 65-70%. To follow the effect of slag on soil chemical properties and the yield of wheat the experimental field consisted of five variants, in three repetitions V_1 (control), V_2 (1 t/ha), V_3 (2 t/ha), V_4 (3 t/ha) and V_5 (5 t/ha).

It was also made a fertilization with 100 kg of nitrogen to follow the combined effect of the amendment and fertilizer with nitrogen on the wheat yield. Wheat variety used in experiments was Glosa. Soil samples were collected in the 0-20 cm and 20-40 cm depth in all experimental variants to follow influence on soil reaction and the wheat yield.

The characteristics of the LF slag are presented in Table 1. Samples of LF slag were analyzed by Optic Spectometry with plasma inductively coupled ICP-OES, for iron, magnesium, aluminium, silica etc.

Table 1

The chemical composition of LF slag

M.U.	Fe	Mg	Al	Si	Na	Ca	Mn	pH
%	10.55	4.10	2.27	8.70	0.034	43.50	0.25	11.08

The material used as amendment has a high content of Ca 43.50% and reaction is strongly alkaline (pH=11.08). In addition to the high content of calcium, has and a high content of magnesium and iron (Mihalache et al., 2013). The heavy metals content is less than maximum allowable limits.

For determining the reaction of the soil used the laboratory WTW 750 pH-meter.

Fig. 1 Experimental fieldfrom Moara Domnească, Ilfov County

RESULTS AND DISCUSSIONS

Applying amendment improved the chemical properties of chromic luvisol by increasing soil reaction with slag applied rate,depending on the application of amendment (Figs. 2 and 3).

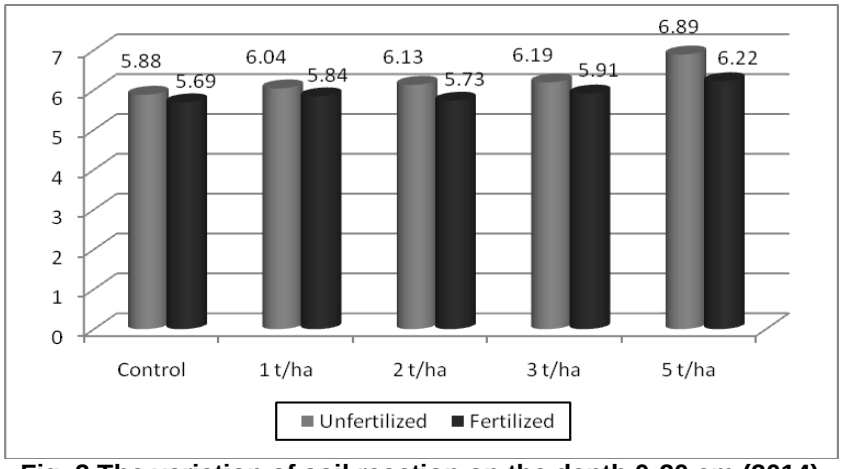

Fig. 2 The variation of soil reaction on the depth 0-20 cm (2014)

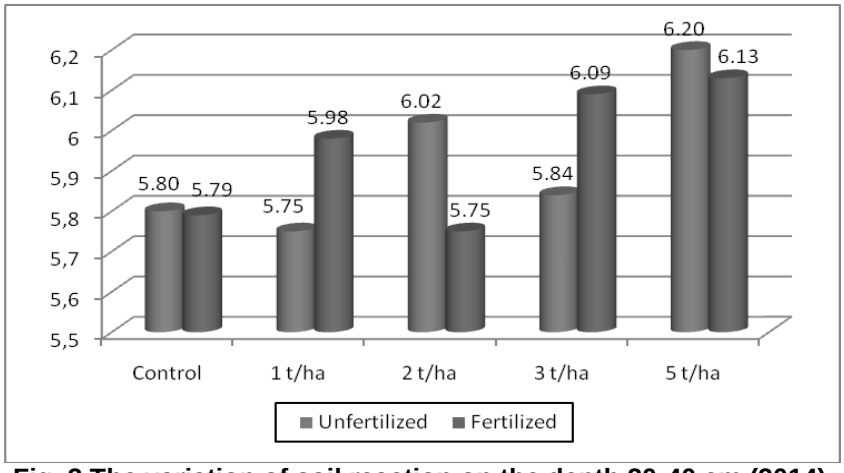

Fig. 3 The variation of soil reaction on the depth 20-40 cm (2014)

Application of different rates of slag in the autumn of 2013 led to the modification of soil reaction on 0-20 cm depth from 5.88 to 6.89 in the control variant by applying a rate of

5 t/ha. The depth of 0-20 cm in the case of nitrogen application, 100 kg/ha, increased reaction was reduced from 5.69 to version 6.22 to control at 5 t/ha slag and fertilized with 100 kg of nitrogen.

On the depth of 20-40 cm soil reaction from unfertilized variants, ranged from 5.80 at the control variant to 6.20 to application a rate of 5 t/ha slag.

Increasing soil reaction in the fertilized variants and improvedwithslag ranged from 5.79 at the control variantto 6.13in thevariant with a rate of 5 t/ha slagand fertilized with ammonium nitrate.

Variants has been monitored remanence of slag on soil reaction revealed its residual effect after maize crop in 2013 with values of about one unit where applied the maximum rates (5 t/ha).

Residual effect of slag on the soil reaction at 20-40 cm depth was reduced from 5.65 to 6.14 when applying the maximum rate of 5 t/ha and from 5.64 to 6.33 when applying slag and nitrogen fertilization. Residual effect of application of LF slag is more pronounced at the soil surface, which shows a weak slag leaching on the soil profile (Figs. 4 and 5).

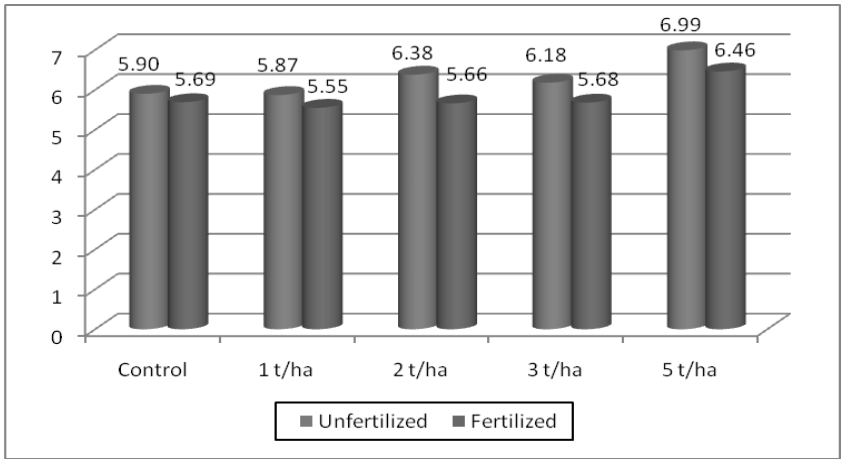

Fig. 4 The variation of soil reaction on the depth 0-20 cm (2013)

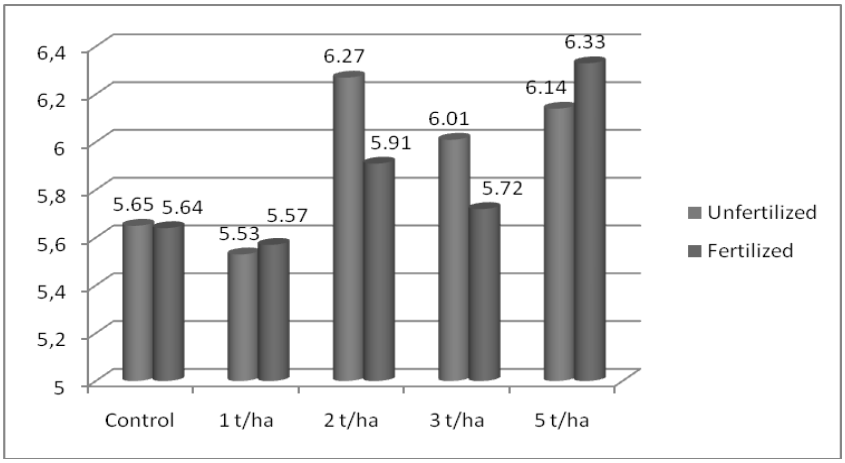

Fig. 5 The variation of soil reaction on the depth 20-40 cm (2013)

Direct application of various rates of slag caused, depending on the rate applied, better wheat crop development,a greater number of ears and a significant increase of wheat yield in 2014 from 4630 kg atcontrol variant to 6320 kg/hain the variant with 5 t/ha. The number of wheat ears was between 482-600 ears/m^2.

Research conducted with various plants showed an increase of production,due to better use of plant nutrients by changing the soil reaction (Figs. 6 and 7).

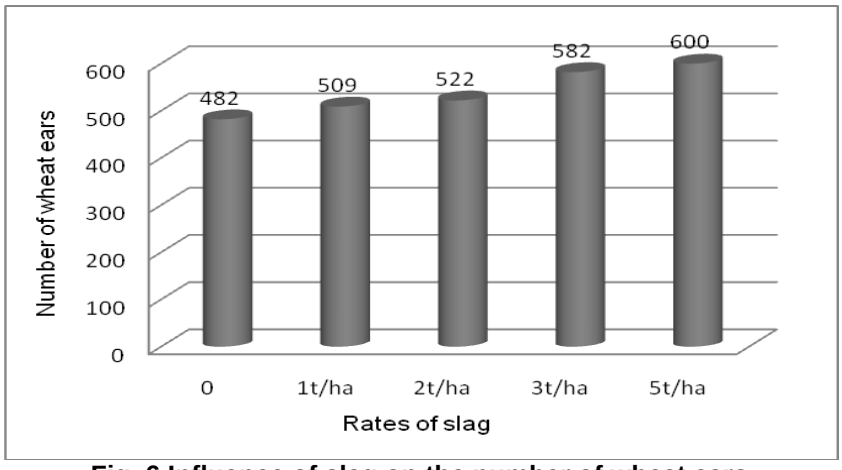

Fig. 6 Influence of slag on the number of wheat ears

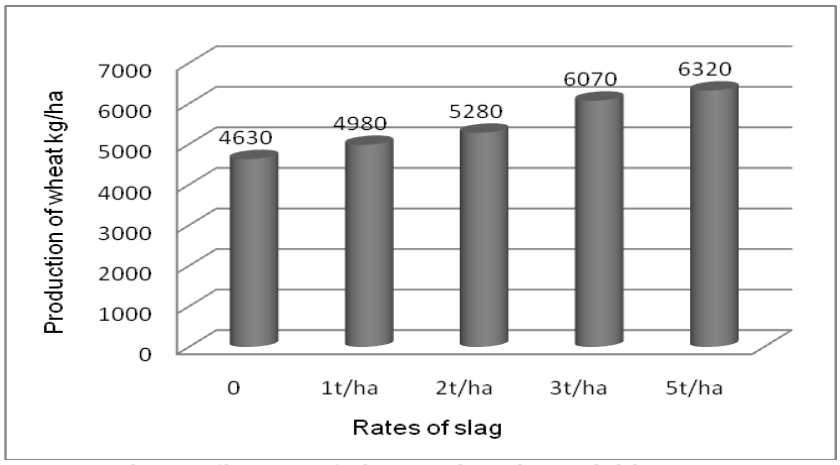

Fig. 7 Influence of slag on the wheat yield - 2014

Residual effect of slag application on wheat yield was thus reduced, wheat crop were recorded a smaller number of ears, between 432-484ears/m^2 and a lower production,4460 kg/ha,at the highest rate (Figs. 8 and 9) .

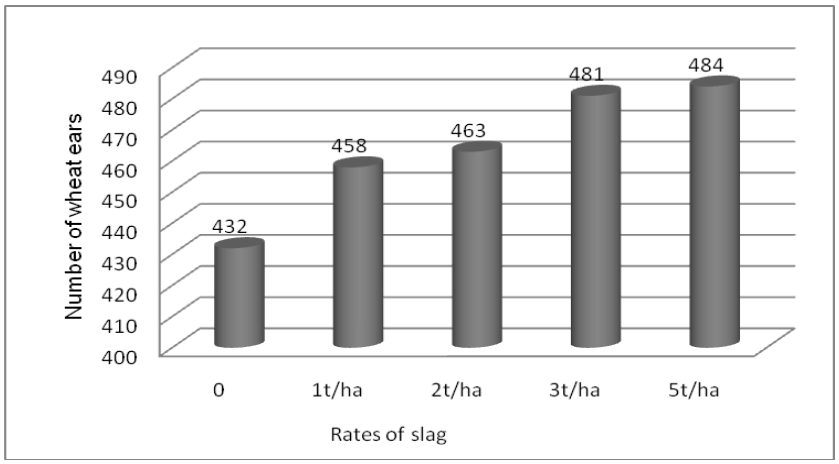

Fig. 8 Influence of slag residual effecton the number of wheat ears

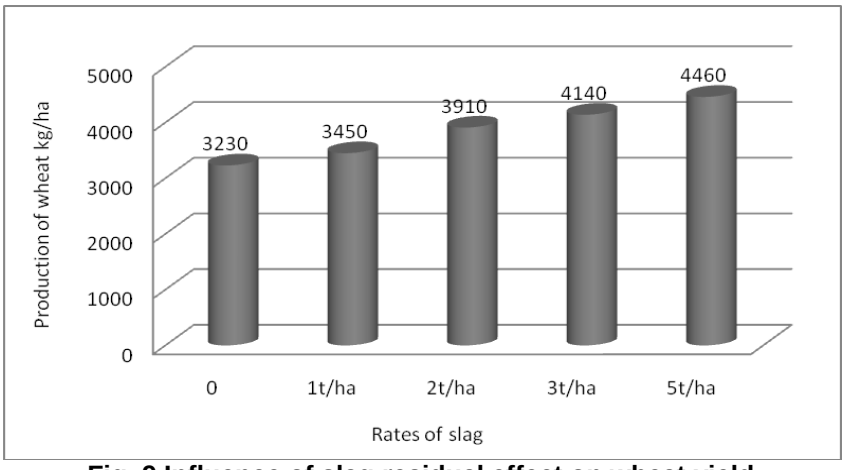

Fig. 9 Influence of slag residual effect on wheat yield

The highest yield in climatic conditions of the year 2014 were recorded by applying slag and fertilization with 100 kgnitrogen, respectively by applying the rate of 2 t/ha yield was 7280 kg/ha and 7870 kg/ha at 5 t/ha. To obtain high yields recommended amendment and mineral fertilizers application (Figs. 10 and 11).

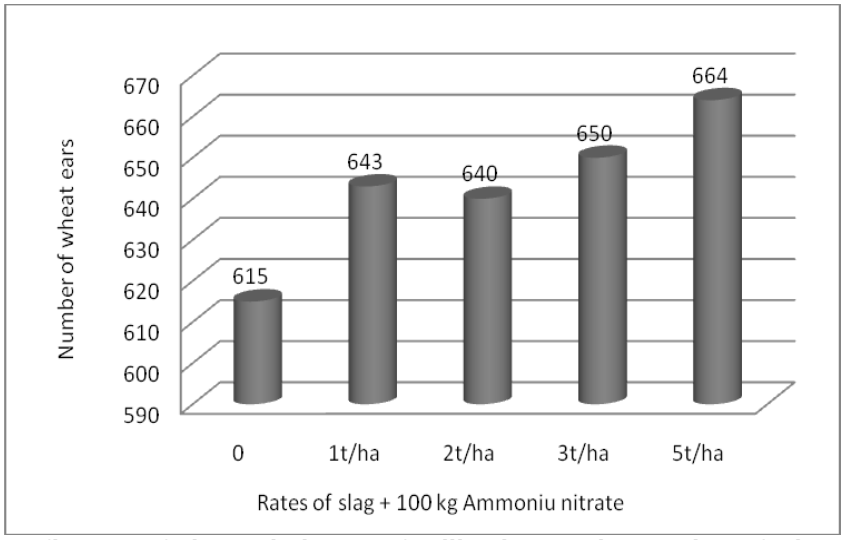

Fig. 10 Influence of slagand nitrogen fertilization on the number of wheat ears

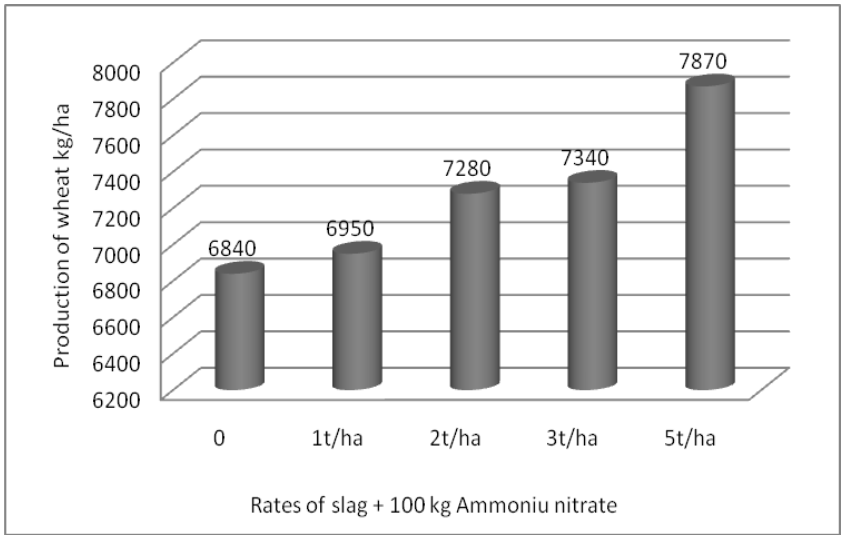

Fig. 11 Influence of slag and nitrogen fertilization on the wheat yield

High yields were obtained for the residual effect of amendmentand application of 100 kg of nitrogen. Highest yield was obtained by applying a rate of 5 t/ha (Figs. 12 and 13).We believe that by applying slagrates 3 t/ha, yield increases are significant under soil and climatic conditions of Moara Domnească.

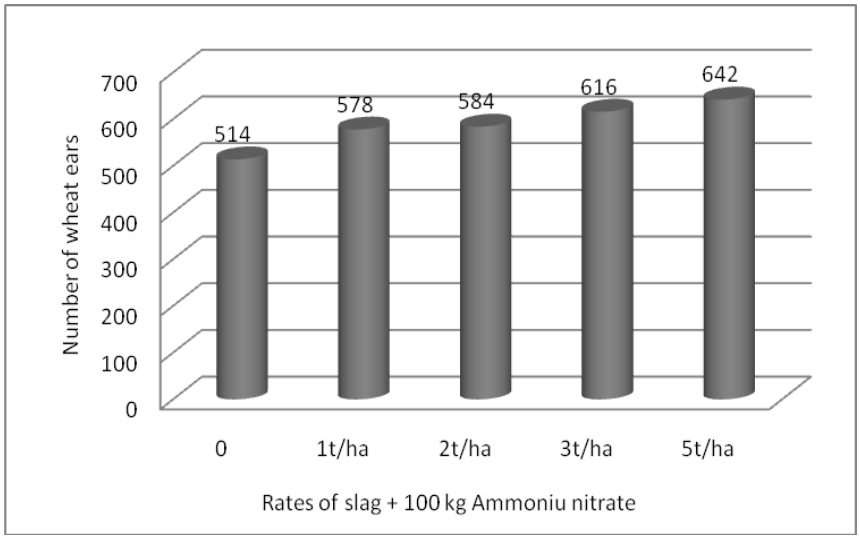

Fig. 12 Influence of slag residual effectand nitrogen fertilizationon the number of wheat ears

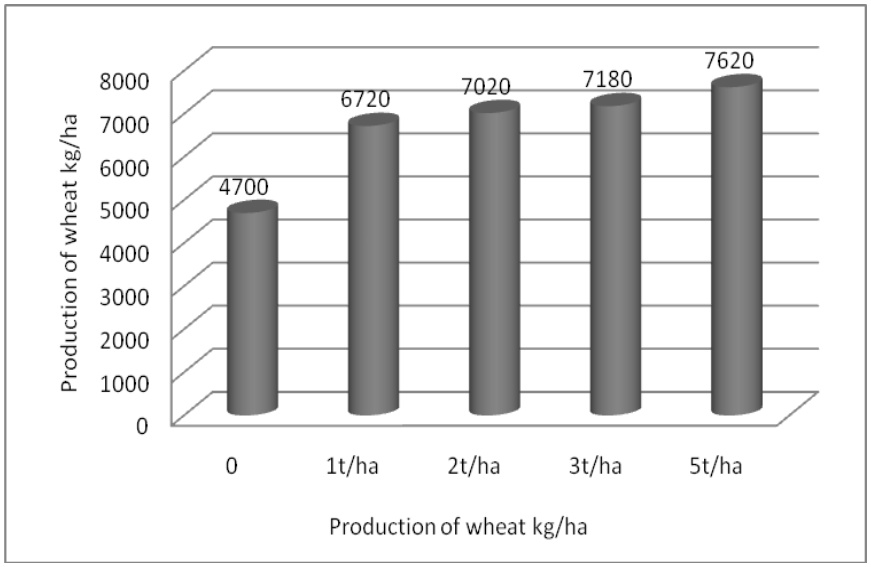

Fig. 13 Influence of slag residual effect and nitrogen fertilization on wheat yield

CONCLUSIONS

Application of different rates of LF slag rich in calcium oxide can improve soil reaction and may be recovered as amendments to correct acidic soil reaction.

Yield increases registered on chromic luvisol under conditions of 2014, on the wheat crop, was significant due to better recovery of nutrients. Largest yield increases were achieved as a consequence of the rate of 5 t/ha with nitrogen mineral fertilizers.

Research have shown that there is a residual effect of slag reflected on soil reaction and increasing yield at rates above 2 t/ha.

Recommended that depending on the chemical composition of the slag and heavy metals content to apply to 3-4 years.

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