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EFFECT OF LIGNITE DISCARD USED IN CROP ROTATION ON SOME CHEMICAL SOIL PROPERTIES AND SPRING TRITICALE YIELD

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A b s t r a c t. A static field experiment carried out on lignite discard, manure and mineral fertilisers in the years 1994 to 1998 was used to study effects on yield and some soil chemical properties of the applied variants of organic and mineral fertilisation: NPK; manure 30 t/ha + NPK; lignite discard 90 t/ha; lignite discard 90 t/ha + NPK.

The present results show that lignite discard contributed to an increase of yield production potential of a good rye complex soil and brought about a significant increase of the triticale grain yield in comparison with the object with manure.

The level of mineral fertilisation applied in the entire crop rotation, in relation to various variants of organic fertilisation (which was applied 3, 2 and 1 year before the examination) exerted a positive effect on pH and the content of basic nutrients in the soil.

K e y w o r d s: lignite, crop rotation, chemical properties, soils triticale yield.

INTRODUCTION

Potatoes are cultivated in Poland mainly on infertile and light soils with low pH. They require systematic organic and mineral fertilisation and quick reaction adjustments.

Due to systematic decrease in livestock population, a considerable number of farms stopped or reduced manure application to root crops. This can impoverish the content of organic matter in the soil, i.e. reduce its fertility. Therefore, various substitutes of manure as an organic fertiliser have been sought. One of them are lignite discards [1,6].

METHODS

Static field experiments were carried out in the Potato Institute, Jadwisin Division, in the years 1994 to 1998. There were 4 repetitions on the good rye complex

soil, using 4 plants (potato, spring triticale, phacelia and yellow lupine for seed production) according to the following scheme: 1 - NPK without organic fertilisation; 2 - cattle manure 30 t/ha + NPK; 3 - lignite discard 90 t/ha; 4 - lignite discard 90 t/ha + NPK.

Before the experiment was started, immediately after forecrop was gathered (in 1994), carbonate dolomite lime at a dose of 1/2 Hh was applied to the whole field.

Organic fertilisation was applied according to the schedule each year in late autumn only for potato, before pre-winter ploughing. In spring mineral fertilisers were applied. The level of portions of mineral fertilisers for particular plants was as follows: potatoes - 90 kg N and P_2O_5 + 135 kg K_2O, spring triticale - 80 kg N and P_2O_5 + 120 kg K_2O, phacelia - 60 kg N + 80 kg P_2O_5 and K_2O, yellow lupine - 80 kg P_2O_5 + 120 kg K_2O per 1 ha.

The lignite dose was established as recommended by vegetable production systems and it was balanced against manure doses most commonly applied in potato growing practice. Both lignite discard and manure was spread with a manure spreader.

In the last year of the experiment (1998), triticale was planted in the whole field and the effect of lignite and manure used 3, 2 and 1 year earlier was tested.

In the autumn of 1994, soil samples were taken from the whole area to determine pH in KCl, organic C, content of available phosphorus, and potassium according to the Egner's method, and magnesium according to the Schachtschabel's method. Similar determinations were made for the soil in the samples taken in the spring of 1998 with regard to the examined objects (with organic and mineral fertilisation). Each year also the samples from the manure and lignite discard were taken in order to make appropriate determinations (Table 1).

Table 1. Content of components in the dry matter of lignite and manure (Jadwisin 1994 to 1997)

Specification	Lignite discard	Cattle manure
Dry matter, %	89.67	18.90
Organic C, in % d.m.	37.50	32.18
N, in % d.m.	0.49	1.80
P, in % d.m.	0.47	0.86
K, in % d.m.	1.20	2.19
Ca, in % d.m.	15.70	1.46
Mg, in % d.m.	4.95	0.43
Mn, ppm	29.83	221.36
Cu, ppm	1.09	8.84
Zn, ppm	11.11	81.72

RESULTS

Statistical analysis of the results showed no significant influence of various fertilisation forms on the diversification of organic C content, phosphorus, potassium and pH of soil and a significant increase of the magnesium content in all fertilisation combinations. It probably stems out from the application (in 1994) of carbonate dolomite lime (Table 2).

Despite the absence of influence of lignite discard on the alteration of the content of some mineral components in the soil (Table 2), the lignite discard applied for potatoes in 1995, 1996 and 1997 contributed to a considerable diversification in the yield of spring triticale seed (Table 3).

A significantly higher yield of spring triticale grains was achieved with the application of lignite discard compared to other objects. It proves its progressive mineralization and ability to render necessary nutrients accessible, as well as probable positive influence on the physical properties of sandy soil.

Application of supplementary mineral fertilisation (NPK) positively influenced the efficiency of the lignite discard which gave a significant effect on the spring triticale yield.

Table 2. Effect of various forms of organic and mineral fertilisation on chemical properties of the soil (Jadwisin 1998)

Soil property	Initial contents in 1994	Treatments			
		NPK	Manure +NPK	Lignite discard	Lignite discard +NPK
Organic C, in %	1.35	1.42	1.42	1.49	1.39
pH in KCl	4.7-5.1	5.1	5.0	5.1	5.3
P_2O_5, mg/100 soil	20.0-38.0	31.1	33.1	35.0	33.0
K_2O, mg/100 soil	15.5-20.5	16.7	15.8	18.0	16.7
Mg, mg/100 soil	2.7-3.0	8.0	7.7	8.2	7.8

Table 3. Effect of lignite discard applied 1, 2 and 3 years before to potato on the yield of grain and straw of spring triticale (Jadwisin 1998)

Treatments	Yield (t/ha)	
	grain	straw
NPK	3.74	5.2
Cattle manure - 30 t/ha + NPK	3.48	4.9
Lignite discard - 90 t/ha	4.55	5.9
Lignite discard - 90 t/ha + NPK	4.77	5.7
$LSD_{0.05}$	0.18	n.s.

The work of Trawczyński and Grześkiewicz [7], in which the effect of lignite discard on the yield of potato tubers and some of its quality properties were evaluated, shows that this fertiliser without mineral fertilisers (NPK) contributed to a significant decrease of the yield as compared to other objects (lignite discard 90 - t/ha + NPK and manure 30 t/ha + NPK as well as NPK).

Further examinations that would help to learn about application of lignite in agriculture, are necessary as the chemical constitution, and in particular, high content of organic carbon in the lignite discard indicate its usefulness in fertilisation of light soils [1,4,5].

CONCLUSIONS

1. The applied organic fertilisation with manure and lignite discard in a static experiment exerted a positive influence on pH and the content of basic nutrients in the soil.

2. The yield of spring triticale grain was significantly increased after fertilisation using the lignite discard in comparison with the object with manure.

3. The lignite discard proved to be a fertiliser which contributed to the increase of yield, and production potential of a good rye soil complex measured by the level of triticale grain yield.

REFERENCES

1. **Bereśniewicz A., Nowosielski O.:** Possibilities of applying lignite in agriculture industry. Post. Nauk Roln., 1, 69-84, 1976.
2. **Bereśniewicz A., Nowosielski O.:** Deacidification and fertilisation properties of lignite Ash Roczn. Nauk Roln., 105, 111-115, 1982.
3. **Bereśniewicz A., Nowosielski O.:** Effect of fertilising with lignite and liming at several levels of mineral fertilisation on yield of vegetables and soil properties. Roczn. Nauk Roln., A, 18-26, 1987.
4. **Lekan S.:** Effect of large portions of peat and fine lignite on properties of sandy soils and plants yield. IUNG, Puławy, 20-86, 1989.
5. **Maciejewska A.:** Ecological aspects of application of lignite to improve properties of sandy soils used in agriculture industry. Zesz. Probl. Post. Nauk Roln., 422, 67-74, 1995.
6. **Nowosielski O., Bereśniewicz A.:** Possibilities of agricultural application of lignite of Konin field in field cultivation. Nowe Roln., 11, 26-28, 1974.
7. **Trawczyński C., Grześkiewicz H.:** Effect of lignite discard on yield and quality of edible Potato. IHAR Bul., 1999.