Tagungsbeitrag zu:
Jahrestagung der DBG, Kommission IV
Horizonte des Bodens, DBG
2.–7. September 2017, Göttingen
Berichte der DBG, http://www.dbges.de

Saponite-containing basaltic tuffs: characteristics and application features

Viktar Bosak, Tatsiana Sachyuka

Introduction

Saponite-containing basaltic tuffs occur at a depth of 40 to 1500 m in the south-western part of the Republic of Belarus.

The basis of saponite-containing tuffs is a clay mineral saponite $(Ca_{0,5},Na)_{0,3}[(Mg,Fe)_3(Si,Al)_4O_{10}](OH)_2 \times 4H_2O$.

The composition of saponite-containing basaltic tuffs in Belarus includes some amount of the following minerals: analcime $Na[AlSi_2O_6] \times H_2O$, hematite α-Fe_2O_3, kaolinite $Al_4[Si_4O_{10}](OH)_8$, feldspars (plagioclase: albite $Na[AlSi_3O_8]$ and anorthite $Ca[Al_2Si_2O_8]$; orthoclase $K[AlSi_3O_8]$), hydromica $K_x(Al,Mg,Fe)_{2-3} \times [Si_{4-x}Al_xO_{10}] \times (OH)_2 \cdot nH_2O$ ($x \leq 0,5$, $n \leq 1,5$), quartz SiO_2.

Saponite-containing basaltic tuffs contains MgO – 6.53–9.87%, K_2O – 0.79–3.46%, $N_{общ.}$ – 0.14–0.18%, P_2O_5 – 0.22–0.24%, Na_2O – 2.31–3.29%, CaO – 0.04–1.94%, FeO – 17.06–24.20%, Al_2O_3 – 11.50–14.49%, SiO_2 – 41.82–57.12%.

The content of active forms of manganese averaged 162.39 mg/kg, cobalt – 4.45 mg/kg, zinc – 35.37 mg/kg, copper – 51.69 mg/kg.

Saponite-containing basaltic tuffs are promising silicate raw materials in the industry (production of Portland cement, ceramics, glass), and can be used as a broad spectrum ameliorant in the agrobiocenosis, as well as natural sorbent of heavy metals and radionuclides. In agriculture saponite-containing basaltic tuffs can be used as a magnesium source for crop feeding.

Objective of the research is to study the possibility of saponite-containing basaltic tuffs application in agriculture.

Belarusian State Agricultural Academy,
BY-213407 Gorki, Belarus, bosak1@tut.by

Material and methods

The research was carried out in the form of field experiments in 2014–2016 in the Minsk region of the Republic of Belarus on the sod-podzolic sandy loamy soil.

Agrochemical characteristics of the soil arable layer had the following indicators: pH_{KCl} 5.5–5.7, content of P_2O_5 (0,2 M HCl) – 135–145 mg/kg, K_2O (0,2 M HCl) – 120–130 mg/kg, humus (0,4 n $K_2Cr_2O_7$) – 2.2–2.4%, CaO (1 M KCl) – 1484–1685 mg/kg, MgO (1 M KCl) – 110–120 mg/kg of the soil.

The experiment scheme provided a control variant without the use of fertilizers, variants with the use of a complete mineral fertilizer NPK (carbamide, ammoniated superphosphate, potassium chloride) and various doses of saponite-containing basaltic tuffs (doses were calculated by magnesium – $Mg_{20\text{-}80}$) in the sowing cultivation of the crops, as well as foliar processing of green beans, peas and basil using 4% solution of magnesium sulfate (Mg_8).

Crops under research – spring wheat (*Triticum aestivum* L.), oats (*Avena sativa* L.), peas (*Pisum sativum* L.), green beans (*Phaseolus vulgaris* L.) and basil (*Ocimum basilicum* L.).

Results and discussion

The experiments on the sod-podzolic sandy loamy soil showed that the application of saponite-containing basaltic tuffs in magnesium doses of $Mg_{20–60}$ increased yield of spring wheat grain by 2.6–5.3 $dtha^{-1}$, oats grain – by 2.4–5.1 $dtha^{-1}$ with a total yield of spring wheat grain amounted to 50.7–53.4 $dtha^{-1}$, oats grain – 33.1–35.8 $dtha^{-1}$ (table 1).

The cultivation of peas and green beans with the application of saponite-containing basaltic tuffs in magnesium doses of $Mg_{40–80}$ increased yield of peas grain – by 3.6–4.5 $dtha^{-1}$, green beans – by 14.2–16.2 $dtha^{-1}$ with a total yield of peas grain amounted to 27.5–28.4 $dtha^{-1}$, green beans – 265.9–267.9 $dtha^{-1}$ (table 2).

The best performance indicators in the cultivation of the grain and leguminous crops under research were archived by applying Mg_{40} against the background of complete mineral fertilizing (NPK).

Preplans application of saponite-containing basaltic tuffs in Mg doses of $Mg_{20–60}$ increased yield of green mass of basil – by 0.16–0.22 kg/m^2 with better agronomic efficiency in case of application of Mg_{20} against the background of complete mineral fertilizing.

Foliar treatment of the crops using magnesium sulfate (Mg_8) increased the yield of peas grain – by 2.8 dtha^{-1}, green beans – by 14.1 dtha^{-1}, green mass of basil – by 0.13 kg/m^2.

Conclusions

The experiments on the sod-podzolic sandy loamy soil with an average content of exchangeable magnesium (110–120 mg/kg of soil) showed that the best indicators of agronomic efficiency in the cultivation of spring wheat, oats, peas, green beans and basil were achieved in case of preplans application of saponite-containing basaltic tuffs in Mg doses of Mg_{40} (grain and leguminous crops) and Mg_{20} (basil) against the background of complete mineral fertilizing.

Key words: saponite-containing basaltic tuffs, magnesium, agriculture, spring wheat, oats, peas, green beans, basil.

Table 1. Influence of fertilizers on productivity of spring wheat and oats

Spring wheat grain, dtha^{-1}			Oats grain, dtha^{-1}		
variants	total yield	increased yield	variants	total yield	increased yield
Control	22.3	–	Control	16.5	–
$N_{90}P_{60}K_{120}$	48.1	–	$N_{70}P_{50}K_{90}$	30.7	–
NPK + Mg_{20}	50.7	2.6	NPK + Mg_{20}	33.1	2.4
NPK + Mg_{40}	53.4	5.3	NPK + Mg_{40}	35.7	5.0
NPK + Mg_{60}	53.1	5.0	NPK + Mg_{60}	35.8	5.1
CD_{05}	2.4		CD_{05}	1.8	

Table 2. Influence of fertilizers on productivity of peas, green beans and basil

Peas grain, dtha^{-1}		Green beans, dtha^{-1}		Green mass of basil, kg/m^2	
variants	total yield	variants	total yield	variants	total yield
Control	12.1	Control	158.1	Control	2.06
$N_{30}P_{60}K_{120}$	23.9	$N_{50}P_{60}K_{120}$	251.7	$N_{45}P_{60}K_{90}$	2.29
NPK + Mg_8	26.7	NPK + Mg_8	265.8	NPK + Mg_8	2.42
NPK + Mg_{40}	27.6	NPK + Mg_{40}	265.9	NPK + Mg_{20}	2.45
NPK + Mg_{60}	28.4	NPK + Mg_{60}	267.9	NPK + Mg_{40}	2.51
NPK + Mg_{80}	27.5	NPK + Mg_{80}	267.1	NPK + Mg_{60}	2.46
CD_{05}	1.5	CD_{05}	12.2	CD_{05}	0.12

References

Numitor, G. (2012) Saponite. Fly Press, 60 p.

Босак, В.Н., Сачивко, Т.В. (2017) Применение сапонитсодержащих базальтовых туфов при возделывании зерновых и зернобобовых культур // Агрохимия, № 9. С. 58–62.

Влияние сапонитсодержащих базальтовых туфов на продуктивность сельскохозяйственных культур (2016) / В.Н. Босак, Г.Д. Стрельцова, О.Ф. Кузьменкова, Т.В. Сачивко // Земледелие и защита растений, № 5. С. 6–9.

Применение сапонитсодержащих базальтовых туфов в земледелии (2016) / В.Н. Босак, Г.Д. Стрельцова, О.Ф. Кузьменкова, Т.В. Сачивко. Минск: БГТУ, 14 с.

Туф базальтовый сапонитсодержащий измельченный: технические условия: ТУ BY 192018546.015-2017 (2017) / Г.Д. Стрельцова, О.Ф. Кузьменкова, В.Н. Босак, Т.В. Сачивко. Минск: Государственный комитет по стандартизации Республики Беларусь, 12 с.

Характеристика и перспективы использования сапонитсодержащих базальтовых туфов (2016) / Г.Д. Стрельцова, О.Ф. Кузьменкова, В.Н. Босак, Т.В. Сачивко // Прыроднае асяроддзе Палесся: асаблівасці і перспектывы развіцця, вып. 9. С. 33–36.