SOIL SCIENCE ANNUAL
2023, 74(1), 162336

https://doi.org/10.37501/soilsa/162336

Effect of anthills on changes in the physico-chemical properties in sandy soil

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Received: 2022-10-25
Accepted: 2023-03-17
Published online: 2023-03-17
Associated editor: A. Józefowska

Keywords:

Ants
Soil exchange complex
Available phosphorus
Available potassium

Abstract

The study objective was the assessment of the effect of anthills on changes in the physico-chemical properties in sandy soil. The research covered two sites (an anthill and a control object) in the Idzbark village in the Stare Jabłonki Forest District, N Poland. Soil samples were collected from the edges of an anthill (from the northern, southern, eastern, and western side), and at a distance of 13.5 m from it (control) from a depth of 0–25 cm. The samples were subject to the determination of soil pH in water and 1 mol KCl dm^{-3} by means of the potentiometric method, content of available forms of potassium and phosphorus by means of the Egner-Riehm method, exchangeable cations in ammonium acetate, as well as content of total organic carbon, nitrogen, and sulphur on a CNS device. The soils proved strongly acidic at both sites, although in the case of the control sample the soil showed considerably lower pH in comparison to soil from the edges of the anthill. Ants also have an effect on the availability of important nutrients in the soil. The study revealed very high content of phosphorus and very low content of potassium in the sampled soil. The comparison of soil samples from the edge of the anthill with control showed that the activity of ants caused an increase in the content of available forms of potassium and phosphorus. In anthills, the content of exchangeable cations such as Ca^{2+}, Mg^{2+}, K^{+}, and Na^{+} was usually higher than in the surrounding habitat. It is the most evident in the case of Mg^{2+} and K^{+} content in the anthill and in control. The activity of ants within the anthill positively affected the physico-chemical properties in sandy soil.

1. Introduction

In the rich and diverse animal kingdom, particular attention should be paid to one of the most diverse groups of social insects from the Formicidae family. Its abundance is estimated for approximately 25 000 species. These small insect occupy almost every continent, abiding in all terrestrial environments, constituting the dominant group of soil macrofauna (Farji-Brener and Werenkraut, 2017). Their high abundance (an anthill can be inhabited by more than a million ants), extensive occurrence (they occur in forested as well as open areas, from extremely dry to very humid, as well as in buildings), activity (they show activity through a major part of the year, with the exception of winter when they hibernate in anthills), and considerable food demand (they are capable of leaving the anthill at a distance of even several tens of metres to obtain food) are associated with their vast role fulfilled in nature (Krzysztofiak and Krzysztofiak, 2006; website 1). Ants are insects able to shape the natural environment in biological, but also physico-chemical terms group of so-called engineer organisms (Del Toro et al., 2012; Kovar et al. 2013; Subedi, 2016; Kumar, 2017; Trigos-Peral et al., 2020). The exceptional character of these animals is related to the aspects of their effect on the environment, and particularly to two of them involving nesting and feeding. Most ant species primarily occurring in the ground (only some of them inhabit buildings) participate in soil-forming processes, affecting physico-chemical soil properties. Moving around, ants build corridors and galleries in the anthill, breaking down and transporting soil particles. It results in a substantial improvement of soil quality, and an increase in soil permeability and aeration, i.e. an increase in its porosity. They can also cause separation of soil particles in terms of their size, affecting physical soil properties (Farji-Brener and Werenkraut, 2017; Trigos-Peral et al., 2020). The activity of ants in soil affects chemical soil properties primarily through a shift of pH towards neutral (an increase in acidity occurs in alkaline soils, and pH increases towards more alkaline in acidic soils, pursuant to the rule that the value of such changes usually does not exceed one pH unit) (Mazur, 2001), and through an increase in the content of nutrients (ants have a tendency for maintaining higher total nitrogen and phosphorus concentration in the soil). The insects also circulate organic matter of plant origin when building anthills from plant fragments above the underground nests. The food and dead ants accumulated in the nests are subject to decomposition and contribute to fertilising the soil. The organisms also cause an increase in cations (soil sampled from anthills has been observed to contain more of them than that sampled from the surrounding areas), as well as nitrogen, potassium, and phosphorus anions (Pisarski, 1975; Frouz and Jílková, 2008; Wagner and Nicklen, 2010; Farji-Brener and Werenkraut, 2017; Wills and Landis, 2017; Trigos-Peral et al., 2020). Ants initiate processes based on increasing the buffer capacity of the nest soil through inhibiting soil activity, and accumulation of carbon and exchangeable cations, leading to cleaning of anthills, i.e. a decrease in contaminants in the nests. It is also determined by a change in the ratio of humification to mineralisation, manifested in an increase in the development of actinobacteria and inhibition of the activity of fungi together (Mazur, 2001). Owing to their abilities, they can be applied in bioindication, usually as indicators of the condition, quality, and variability of habitats.

These exceptional social insects cover a vast number of species, but this article focuses on one, commonly occurring in Poland, namely red wood ant (*Formica rufa*). The insects are known to belong to social organisms, i.e. those showing the following features: representatives of minimum two generations living together in one family, and the offspring is taken care of by family members, also assigned to specific obligations. Red wood ants have a characteristic reddish colour, most visible on the head and body core. The rest of the body is grey and black. The ants have the exceptional ability to build enormous anthills, primarily covered with twigs, grass blades, leaves, needles, and anything the insects find in the forest. The side of the anthill with the gentlest slope is the southern side. It is also the broadest, and heats up the fastest, providing ants with the best conditions for development. Anthills of forest ants, including red wood ants, can reach impressive sizes of up to 2–3 m, although they usually measure 1 m, and extend over several metres in width (website 2, website 3, website 4). Pursuant to the Regulation of the Minister of the Environment as of 16 December 2016 on the protection of animal species, *Formica rufa is* under partial protection (Regulation ME, 2016).

Accordingly, the objective of this study, was to evaluate the effect of anthills of *Formica rufa* on changes in the physicochemical properties in sandy soil.

2. Materials and methods

2.1. Description of the study area

The studied anthill is located in a deciduous-coniferous forest in the Idzbark village in the Warmia and Mazury Voivodeship, Ostródzki district, Ostróda commune, at Lake Ostrowin in the Stare Jabłonki Forest District, N Poland (geographical location: 53°40'6.32"N, 20°04'30.1"E).The anthill is located more precisely in mixed coniferous forest, where the dominant species is pine, there is also a lot of spruce (the main species next to pine), while admixture species are beech, oak, oak, larch, birch, fir, small-leaved linden. It is covered by a Natura 2000 habitat area – Drwęca River valley (area code: PLH280001), next to the Drwęca River nature reserve, Area of Protected Landscape of the Upper Drwęca River valley, and in the area of protected landscape of the Tabor Forests. Soil in the study area are classified, according to WRB 2015 (FAO, 2015) as Podzols and belong, according to „Polish Soil Classification" (Kabała et al., 2019) to VI bonitation class. The parent material is mainly sands and gravels of glacial waters (sandstone). The anthill has existed for at least 8 years. It extends over 120 cm in the north-south direction, and over 130 cm in the east-west direction. It has so far reached a height of 35 cm (Fig. 1). In the vicinity of the anthill, there is a somewhat smaller anthill at a distance of 13.5 m towards the north-west. It developed 6 years ago, and has reached a height of 22 cm. It extends over 100 cm in the north-south direction, and 110 cm in the east-west direction.

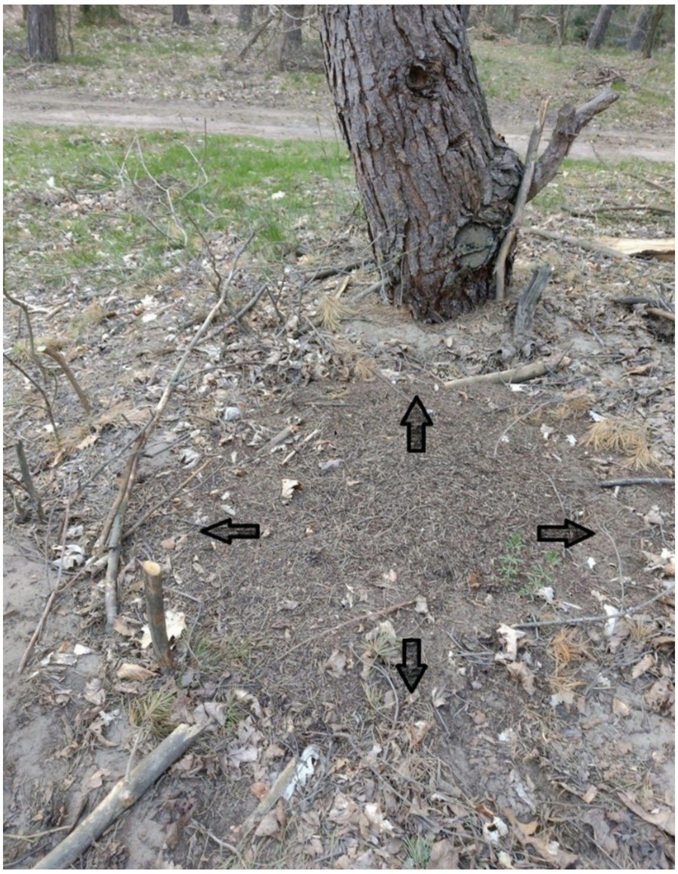

Fig. 1. Location of the anthill with the wind rose (source: Daria Urbańczyk 2022)

2.2. Soil sampling and sample analysis

Soil samples for analysis were collected in accordance with the wind rose from a depth of 0–25 cm by means of an Egner rod. The soil in the study area had an organic horizon that had been removed prior to sampling. Each collective sample covered 4 punctures. A total of 5 samples were collected: the first sample was collected north of the anthill at a distance of 120 cm from the centre of the anthill, second one – 120 cm southwards, third – 130 cm eastwards, and fourth 130 cm westwards (Fig. 1). A fifth control sample was also collected at a distance of 10 m from the anthill.

The collected samples were subject to the determination of the following properties:

- soil pH in water and 1 mol KCl dm^{-3} by means of the potentiometric method on a device by Schott pH meter (Tyszkiewicz et al., 2019);
- available forms of phosphorus and potassium by means of the Egnera-Riehm method (Stafecka and Komosa 2004),
- total exchangeable cations in ammonium acetate by means of the Kappen method (ThermoElemental SOLAAR M6 apparatus (Ostrowska et al. 1991),
- total organic carbon, total nitrogen, and total sulphur content on a CNS ThermoElemental device

Evaluation of multivariate relationships were performed using principal component analysis (PCA). The aim of the analysis was presentation of correlations between content of selected elements and multivariate characteristics of the studied samples. The results of PCA were presented as a biplot based on two principal components (PC1 and PC2). It allow to evaluated multivariate differences between the studied samples. The analyses were performed in Statistica 13.3.

3. Results and discussion

3.1. Soil reaction

The study results considerably differ, because soil pH measurements conducted in water suspension are higher than those performed in 1 mol KCl dm^{-3}. It should be emphasised that soil pH measurement both in water and KCl solution with a concentration of 1 mol dm^{-3} revealed strong acidity of the soils (pH in H_2O < 5.0; pH in 1M KCl dm^{-3} < 4.5), and that sample 5 (control) collected at a distance of 10 m from the anthill had the lowest pH (pH in water – 4.0, pH in 1M KCl dm^{-3} – 3.2). It suggests that soils surrounding the anthill belong to acidic and strongly acidic soils (Table 1). The pH measurement in 1 mol KCl dm^{-3} appears more quantifiable than that in water suspension in terms of determination of the actual state of soil acidity, because it also concerns H^+ ions that are easily subject to transition from the solid phase of soil that retains them the weakest to the liquid phase during actively occurring changes in soil conditions. Results obtained by means of that method show that the activity of ants increases soil acidity in the place of occurrence of anthills, i.e. ants increase pH in acidic soils and reduce it in alkaline soils (Frouz and Jílková, 2008). The highest

Table 1
Values of soil pH

Samples	Soil pH in H_2O	Soil pH in KCl
1.	4.5	3.7
2.	4.7	3.5
3.	4.4	3.5
4.	4.5	3.4
5.	4.0	3.2

Note: The first sample was collected north of the anthill at a distance of 120 cm from the centre of the anthill, second one – 120 cm southwards, third – 130 cm eastwards, and fourth 130 cm westwards. A fifth control sample was collected at a distance of 10 m from the anthill.

pH value of 3.7 was determined for sample 1, collected north of the anthill near a tree. South and east of the anthill, soil pH was somewhat lower (pH 3.5 and pH 3.5). The lowest pH (excluding the control sample) concerned sample 4, collected west of the anthill (pH 3.4) (Table 1). Many studies showed a considerable effect of ants on soil pH and other chemical properties. That effect intensifies with age of the anthill.

3.2. Content of available forms of potassium and phosphorus

The activity of ants can have an effect on the availability of important nutrients in soil. In ant nests, the content of nutrients easily available for plants is usually higher than in the surrounding habitat (literature). The greatest differences are observed when the soil surrounding the nest is poor in such nutrients. It has been observed that even in abandoned anthills, higher concentrations of these substances are maintained longer, and after two years they reach a level characteristic of a given habitat (Pętal, 1980). The analysed anthill also showed higher than average contents of available forms of K and P in samples collected from the anthill in comparison to the soil surrounding the anthill (Table 2). In the case of available forms of potassium, their content ranged from 32 to 40.8 mg K kg^{-1}. The content of available potassium in mineral soils in accordance with PN-R-04022:1996/Az1:2002 (where potassium content is expressed in mg/100 g of soil) suggests that the soil sampled from the anthill has low potassium content (content class IV–V). It should be emphasised, however, that the activity of ants causes an increase in that element in soil. It can be observed in the comparison of the control sample (collected at a distance of 10 m from the anthill) with samples collected from the anthill, where the difference in the content is approximately 5-fold. The highest K content was determined in sample 3, collected east of the anthill (40.8 mg K kg^{-1}). In sample 5 (control), content of only 6.5 mg K kg^{-1} was recorded.

In the case of content of available forms of phosphorus, the concentration was within a range from 97.8 mg P kg^{-1} to 116.8 mg P kg^{-1}. Content of available phosphorus in mineral soils in accordance with PN-R-04023:1996 suggests that the soil sampled from the anthill has very high phosphorus content (content

Table 2
Content of available forms of potassium and phosphorus (mg·kg^{-1})

Samples	K	P
1.	38.6	97.8
2.	39.9	113.6
3.	40.8	116.8
4.	32.0	113.6
5.	6.5	25.0

Note: The first sample was collected north of the anthill at a distance of 120 cm from the centre of the anthill, second one – 120 cm southwards, third – 130 cm eastwards, and fourth 130 cm westwards. A fifth control sample was collected at a distance of 10 m from the anthill.

class I). Also in this case, the activity of ants causes an increase in phosphorus content. The difference between the samples collected from the anthill and the control sample is more than 4-fold. The highest P content was also recorded in sample 3, collected east of the anthill (116.8 mg P kg^{-1}). In sample 5 (control), content of only 25 mg P kg^{-1} was recorded.

3.3. Content of total exchangeable cations

In ant nests, content of exchangeable cations such as Ca^{2+}, Mg^{2+}, K^+, and Na^+ is usually higher than in the surrounding habitat (Pętal, 1980). In the analysed anthill, the greatest difference between the content of exchangeable cations in the anthill and the surrounding habitat is observed in the case of cations Mg^{2+} and K^+ (Table 3).

In the case of cations K^+, their content varied from 9.4 cmol(+) kg^{-1} to 12.7 cmol(+) kg^{-1}. The control sample collected at a distance of 10 m from the anthill showed content of only 4 cmol(+) kg^{-1}. This suggests that the activity of ants contributes to an increase in the content of K+ cations. Mg^{2+} cations showed content varying from 1.3 cmol(+) kg^{-1} to 3.6 cmol(+) kg^{-1}. The comparison of these contents with the content obtained in the control sample reaching 0.7 cmol(+) kg^{-1} also suggests that the activity of ants causes an increase in the content of magnesium in the soil. Smaller differences in contents were observed in the case of Ca^{2+} cations, with concentration in the anthill ranging from 12.8 cmol(+) kg^{-1} to 29.2 cmol(+) kg^{-1}, whereas in the control sample it reached 15.5 cmol(+) kg^{-1}. A similar situation was observed for Na^+ cations, with content in the anthill in a range from 0.4 cmol(+) kg^{-1} to 0.7 cmol(+) kg^{-1}, and in the control sample reaching 0.4 cmol(+) kg^{-1}. Therefore, the activity of ants also to a lower degree contributes to an increase in the content of Ca^{2+} and Na^+ cations. It is worth emphasising that sample 3 collected 130 cm east of the centre of the anthill was characterised by the highest content of both Mg^{2+}, Ca^{2+}, K^+, and Na^+ cations (Table 3).

3.4. Content of carbon, nitrogen, sulphur and C/N ratio

The activity of ants can also affect the content of TOC, nitrogen, and sulphur in soil. At the site of occurrence of the anthill, higher concentration of among others total nitrogen or carbon accumulation is observed, caused by collecting food and accumulation of dead ants or other small organisms subject to decomposition (Frouz and Jilková 2008, Kłyś et al., 2017). They also contribute to a change in the ratio of humification to mineralisation in the anthill (Mazur, 2001).

The analysed soil contained from 20.9 gkg^{-1} to 39.4 gkg^{-1} of TOC. It is more than twice as much as in the control sample collected from the habitat surrounding the anthill that contained only 10 gkg^{-1} of TOC. This suggests that ants contribute to an increase in TOC in soil that in turn increases soil fertility. In the case of total nitrogen, the difference between control and samples collected from the anthill is much smaller. Soil from the anthill contained only 1.4 gkg^{-1}–2.0 gkg^{-1} of total nitrogen, and that from the control sample 0.8 gkg^{-1} of total nitrogen, i.e. it was more than twice higher, but still inconsiderable. The C/N ratio in the soil from the anthill was 19.7–14.9, which means that slow decomposition and accumulation of organic matter occurs in this soil. In the control sample, the C/N ratio was lower, it was 12.5, which means faster decomposition of organic matter in the soil. The analysed soil showed very small content of total sulphur, within a range of 0.2 gkg^{-1} – 0.5 gkg^{-1}. In the control sample, an even lower result was recorded, reaching 0.1 gkg^{-1} of total sulphur (Table 4).

Table 3
Content of exchangeable cations (cmol (+)·kg^{-1})

	Exchangeable cations			
Samples	K	Na	Mg	Ca
1.	8.4	0.7	1.8	17.8
2.	10.4	0.4	1.3	12.8
3.	12.7	0.7	3.6	29.2
4.	10.6	0.4	1.6	16.7
5.	4.0	0.4	0.7	15.5

Note: The first sample was collected north of the anthill at a distance of 120 cm from the centre of the anthill, second one – 120 cm southwards, third – 130 cm eastwards, and fourth 130 cm westwards. A fifth control sample was collected at a distance of 10 m from the anthill.

Table 4
Content of total organic carbon, nitrogen, sulphur and C/N ratio (g·kg^{-1})

	Name			
Samples	TOC	N	S	C/N
1.	39.4	2.0	0.5	19.7
2.	27.8	1.8	0.3	15.4
3.	32.0	2.0	0.3	16.0
4.	20.9	1.4	0.2	14.9
5.	10.0	0.8	0.1	12.5

Note: The first sample was collected north of the anthill at a distance of 120 cm from the centre of the anthill, second one – 120 cm southwards, third – 130 cm eastwards, and fourth 130 cm westwards. A fifth control sample was collected at a distance of 10 m from the anthill.

3.5. PCA analysis

The chart above shows the results of the PCA in the form of a biplot (Fig. 2). The first two principal components (PC1 and PC2) explain most of the multi-trait variability, in total more than 85% (PC1 66.4% and PC2 19.2%). This means that the PCA results well characterize the relationships between individual elements and well characterize the multi-trait diversity of the tested samples. Based on the above PCA chart, we can conclude that strongly positively correlated are P, K (K1– cations K+ and K2 – available forms of potassium) and C/N. In addition, cations Mg, Na and Ca are strongly positively correlated. The highest values of all tested traits were found for sample 3 and the lowest for sample 5. The most similar to each other were samples 2 and 4, which had average values for most of the tested traits (Fig. 2).

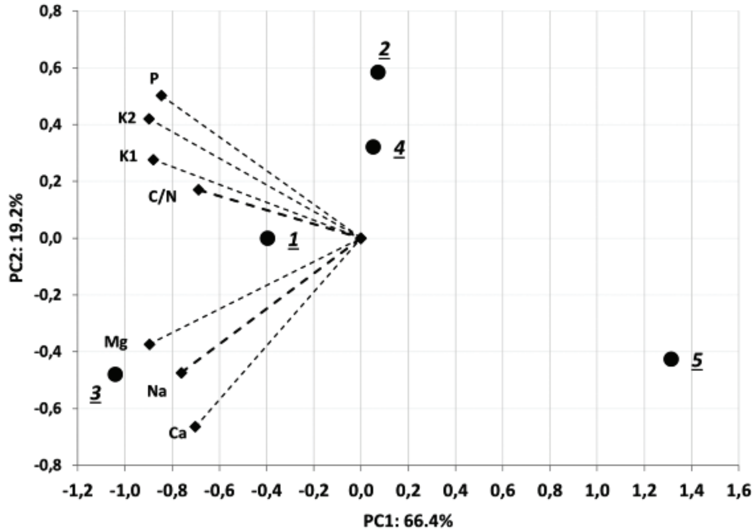

Fig. 2. PCA analysis

4. Conclusions

(1) Soils collected from anthills are characterised by strongly acidic reaction. The activity of ants raises soil pH at the site of occurrence of anthills.

(2) Anthills contribute to an increase in the content of available forms of potassium and phosphorus in soil.

(3) In ant nests, the content of exchangeable cations such as Mg^{2+} and K^{+} is higher than in the surrounding habitat.

(4) The activity of ants contributes to an increase in the content of TOC in soil and to a small degree to an increase in total nitrogen and sulphur.

Acknowledgments

The authors are highly grateful to the Chair of Agricultural and Environmental Chemistry, Institute of Agriculture, Faculty of Agriculture and Ecology, Warsaw University of Life Sciences for providing laboratory supports to conduct this research.

References

Del Toro, I., Ribbons, R., Pelini, S., 2012. The little things that run the world revisited: a review of ant-mediated ecosystem services and disservices (Hymenoptera: Formicidae). Myrmecological News 17, 133–146.

Farji-Brener, A.G., Werenkraut, V., 2017. The effects of ant nests on soil fertility and plant performance: a meta-analysis. Journal of Animal Ecology 86, 866–877. https://doi.org/10.1111/1365-2656.12672

Food and Agriculture Organization of the United Nations, 2015. World Reference Base for Soil Resources 2014, Update 2015. International Soil Classification System for Naming Soils and Creating Legends for Soil Maps. World Soil Resources Reports No. 106.

Frouz, J., Jilková, V., 2008. The effect of ants on soil properties and processes (Hymenoptera: Formicidae). Myrmecological News 11(11), 191–199.

Kłyś, M., Malejky, N., 2017. Gleba – środowisko życia wielu organizmów. Edukacja Biologiczna i Środowiskowa 4, 41–46.

Kovar P., Vojtisek P., Zentsova I., 2013. Ants as Ecosystem Engineers in Natural Restoration of Human Made Habitats. Journal of Landscape Ecology 6(1), 18–31. https://doi.org/10.2478/v10285-012-0061-9

Krzysztofiak, L., Krzysztofiak, A., 2006. Mrówki środowisk leśnych Polski-przewodnik terenowy. Stowarzyszenie Człowiek i Przyroda, Suwałki, 3–40.

Kumar, R., 2017. Ants as Engineers of Biodiversity and Ecosystem. International Journal of Advance Research in Science and Engineering 6(1), 744–746.

Mazur, S., 2001. Aktywność biologiczna mrówek na zalesianych gruntach porolnych. Sylwan 10, 35–39.

Ostrowska, A., Gawliński, S., Szczubiałka, Z., 1991. Metody analizy i oceny właściwości gleb i roślin. Instytut Ochrony Środowiska, Warszawa.

Pętal, J., 1980. Ant populations, their regulation and effect on soil in Meadows. Ekologia polska 28, 297–326.

Pisarski, B., 1975. Mrówki-Formicoidea. Katalog fauny Polski, Warszawa, 3–7.

Regulation ME, 2016. Regulation of the Minister of the Environment of December 16, 2016onthe protection of animal species. https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20160002183

Stafecka, A., Komosa, A., 2004. Wpływ suszenia prób gleb sadowniczych na zawartość fosforu, potasu i magnezu oznaczanych metodą uniwersalną, Egnera-Riehma i Schachtschabela. Rocznik Akademii Rolniczej w Poznaniu – CCCLVI, Ogrodn. 37, 199–208.

Subedi, I.P., 2016. Ants – ecosystem engineers. KIST Newsletter 1(1), 9–10.

Trigos-Peral, G., Witek, M., Czechowski, W., 2020. Mrówki Pola Mokotowskiego w Warszawie. Wydawnictwo Uniwersytetu Warszawskiego, Warszawa, 73–81.

Tyszkiewicz, Z.E., Czubaszek, R., Roj-Rojewski, S., 2019. Podstawowe metody laboratoryjnej analizy gleby. Skrypt do zajęć laboratoryjnych z przedmiotu gleboznawstwo dla studentów kierunku architektura krajobrazu Politechniki Białostockiej. Oficyna Wydawnicza Politechniki Białostockiej, Białystok, 37–39.

Wagner, D., Nicklen, E.F., 2010. Ant nest location, soil nutrients and nutrient uptakeby ant-associated plants: does extra floral nectar attract ant nests and thereby enhance plant nutrition? Journal of Ecology 98, 614–624.

website 1: https://swiatmakro.com/2016/04/28/mrowki-lesne-z-rodzaju-formica-brutalne-ale-pozyteczne/

website 2: Mrówki leśne z rodzaju Formica – brutalne, ale pożyteczne! | Świat Makro.com (swiatmakro.com)

website 3: Formica rufa – Mrówka rudnica i gatunki bliźniacze | Insektarium

website 4: https://www.focus.pl/artykul/doskonaa-spoeczno-mrwek

Wills, B.D., Landis, D.A., 2017. The role of ants in north temperate grasslands: a review. Oecologia 186, 323–338.

Ocena wpływu mrowisk na zmiany właściwości fizyko-chemicznych gleby piaszczystej

Słowa kluczowe

Mrówki
Kompleks wymiany glebowej
Przyswajalny fosfor
Przyswajalny potas

Streszczenie

Celem badań była ocena wpływu mrowisk na zmiany właściwości fizyko-chemiczne gleby piaszczystej. Badaniami objęto dwa stanowiska (mrowisko i obiekt kontrolny), które zlokalizowane były we wsi Idzbark w Nadleśnictwie Stare Jabłonki. Próbki gleby zostały pobrane z obrzeży mrowiska (z północnej, południowej, wschodniej i zachodniej strony) oraz w odległości 13,5 m od niego (kontrola) z głębokości 0–25 cm. W próbkach oznaczono odczyn gleby w wodzie i 1 mol KCl dm^{-3} metodą potencjometryczną, zawartość przyswajalnych form potasu i fosforu metodą Egnera-Riehma, sumę kationów wymiennych w octanie amonu oraz zawartość węgla, azotu oraz siarki na aparacie CNS. Na obu stanowiskach gleby okazały się silnie kwaśne, jednak w przypadku próby kontrolnej gleba posiadała znacznie niższe pH w porównaniu do gleby z obrzeży mrowiska. Mrówki również mają wpływ na dostępność ważnych składników odżywczych w glebie. W przeprowadzonych badaniach stwierdzono, że pobrana gleba posiadała bardzo wysoką zawartość fosforu oraz bardzo niską zawartość potasu. Porównując próbki gleby z obrzeży mrowiska w stosunku do kontroli trzeba zaznaczyć, że aktywność mrówek spowodowała wzrost zawartości przyswajalnych form potasu i fosforu. W gniazdach mrówek zawartość kationów wymiennych, takich jak Ca^{2+}, Mg^{2+}, K^+, Na^+, była przeważnie wyższa niż w otaczającym siedlisku. Najbardziej widać to w zawartości Mg^{2+} i K^+ znajdujących się w mrowisku i w próbie kontrolnej. Aktywność mrówek w obszarze mrowiska pozytywnie wpłynęła na zmiany właściwości fizyko-chemiczne gleby piaszczystej.