
WATER RETENTION ABILITY OF PANAMIN AGRO FERTILIZER ON BASE OF VOULCANIC ROCK POWDER

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Abstract: The purpose of present study is to be revealed the possibility of rock meal powder to retain water in the soil when the same product is applied as a non-organic fertilizer. Soil water retention became more and more important in the agriculture during the recent years due the climate changes, hotter summers and less rains. Its important to figure out is applied fertilizers in the soil changed its water retention ability. Panamin Agro® is a finely ground rock flour derived from natural, Austrian volcanic rocks. It's consisted mainly from calcium carbonate – 38.11 %, magnesium carbonate – 18.48 % and silicone dioxide – 16.8 % as well as some minor elements as potassium dioxide – 0.91 %, phosphate – 0.01 % and iron oxide – 0.52 %. Panamin Agro is used as a fertilizer in various crops as cereals, orchards, vegetables, essential oil crops, and grapes. It can be applied both as soil and leaves treatments. The present research was studying the water retention ability of soil amended (or fertilized) with this natural product. The trials were conducted in *in vitro* conditions for elimination of the butterfly effect and maximum accuracy of the results. Additionally - both distilled and very hard water (196 ppm CaCO₃) were used in the trials for estimation the influence of the water hardness in the process of soil water retention. The readings of results were made 24, 48 hours and 7 days after the start of the tests. The results show that hardness of the water does not play a role in the water retention of the soil ($p>0.05$) i.e. there is no difference if the irrigation of the plants is made by soft or hard water towards its ability to be retained from the soil. However – the application of rock powder (Panamin Agro® in this case) in doses of 80 – 100 grams per kg soil or 0.8 - 1 kg Panamin Agro per square meter, can significantly decrease water losses from the soil i.e. increase water retention ability of the soils fertilized by this product on the base of rock meal powder. It was found also in this research, that rock dust can achieve better water retention of the soil when water hardness in bigger. So even through that received results shows that hardness of the water does not play a role in the water retention of the soil, when this product on the base of rock power is applied in the soil in doses of or 0.8 - 1 kg per square meter, using the hard water will achieve better water retention and respectively – effectiveness in the soil. Panamin Agro can persist in the soil for several years, which on the other hand makes these high doses economically acceptable. Even after 7 days, soil amended with Panamin Agro can preserve some of the water in the conducted *in vitro* tests. The future trials must be conducted to be revealed is this better soil water retention can be achieve only with Panamin Agro or with other products on the base of rock meals or clays.

Keywords: fertiliser, soil, clay, rock powder, Panamin, water retention

1. INTRODUCTION

The water retention of the soils is one of the most important their prosperity directly linked to the soil functioning and yields. Water losses of soil can significantly reduce arable lands especially during recent years when climate changes are fact (Rawls et al, 2003). Actually soil and water are two fundamental resources of our agricultural environment and used fertilizers and pesticides directly play influence on them (Rawls et al, 1991). Different hydrologic and ecologic processes are impacted by the storage capacity of soil water, which is dictated by the profile thickness and water retention properties of soil from which with major role is the soil texture (Geroy et al, 2011).

However, other soil properties as soil type, organic matter content, calcium carbonate content, pH also play important role in the water capability (Tóth & Makó, 2014). The addition of non – organic or organic fertilizers to the soil also can change greatly its water capacity (Liang et al, 2007; Liang & Liu, 2006), especially when soil is mixed with animal manure (Nyamangara et al, 2001; Liyanage & Leelamanie, 2016) or charcoal (Villagra-Mendoza, 2017; Cheng et al, 2024) or wood ash (Stoof et al, 2010; He et al, 2025). Organic matter in the soil is an important determinant of available water capacity and yields of the crops (Hudson, 1994). However it is very disputable due to the fact that other studies claim that the effect of organic matter on water retention of soils is limited (Minasny & McBratney, 2018). For increasing water capability of the soils, various improved fertilizers or amendments were created and investigated (Liang & Liu, 2006; Wu et al, 2008; Lu et al, 2023). However one of the cheapest and widely available method for increasing the water retention of the soils is incorporation of different clays into them alone of amended with other materials (Villar, 2007; Ajayi & Horn, 2016 Wong et al, 2017). Was established that clay soils held approximately 1.95 in./ft water (Salter & Williams, 1965). Variation of this approach is using various rock powders which gaining popularly as effective and cheap fertilizers with high content of silicate minerals in them. Research over the past 50 years on silicate rocks focused on soil fertility management and

agricultural productivity. Silicate rock powders are applied in natura, have long-lasting residual effects and reduce greenhouse gas emissions (Ramos et al, 2022). The use of rock powders as soil amendment can improve nutrient and soil chemical properties (Paula De Souza et al, 2018). They can improve soil quality, including lower bulk density, higher porosity, improved soil microbial communities, and improved nutrient status (Armah et al, 2025). Basalt rock powder, a by-product of basalt mining can be an eco-friendly stabilizer for soft clay soils and improve the water retention (Pathak & Hayano, 2025). Was found that the application of gneiss powder improved the quality of soil cultivated with coffee, The increase in soil quality indicators was reflected in coffee plants, which produced beans with better attributes (Swoboda et al, 2025). Rock weathering can substantially improve the carbon sequestration potential of ground rock application on agricultural land. Higher soil organic carbon levels can have further soil and plant benefits, such as increasing nutrient and water retention (Buss et al, 2024; Dupla et al, 2025). In the present study a water retention ability of rock powder derived from natural, Austrian volcanic rocks used as agricultural fertilizer under trade name Panamin Agro was investigated.

2. MATERIALS AND METHODS

Plastic cups with 70 ml volume were used for placing 10 grams of soil in each of them mixed with Panamin Agro in 10 different concentrations – from 1 to 10 %. The control variant was only with soil. The used soil was from alluvium type, sandy loam texture, with content: 66 % sand, 21 % silt and 11 % clay, with diameter of particles 5 mm, with bulk density 0.85 g /cm³ . Five milliliters of water was poured into each cup. The trials were conducted with distilled water and very hard top water (196 ppm CaCO₃). Each test variant was consisted of 10 replicates (cups). The cups were weighed and placed in the thermostat at 20°C temperature. The readings of results were made 24, 48 hours and 7 days after the beginning of the test by weighing the cups. The percent of water in the soil was calculated by the formula:

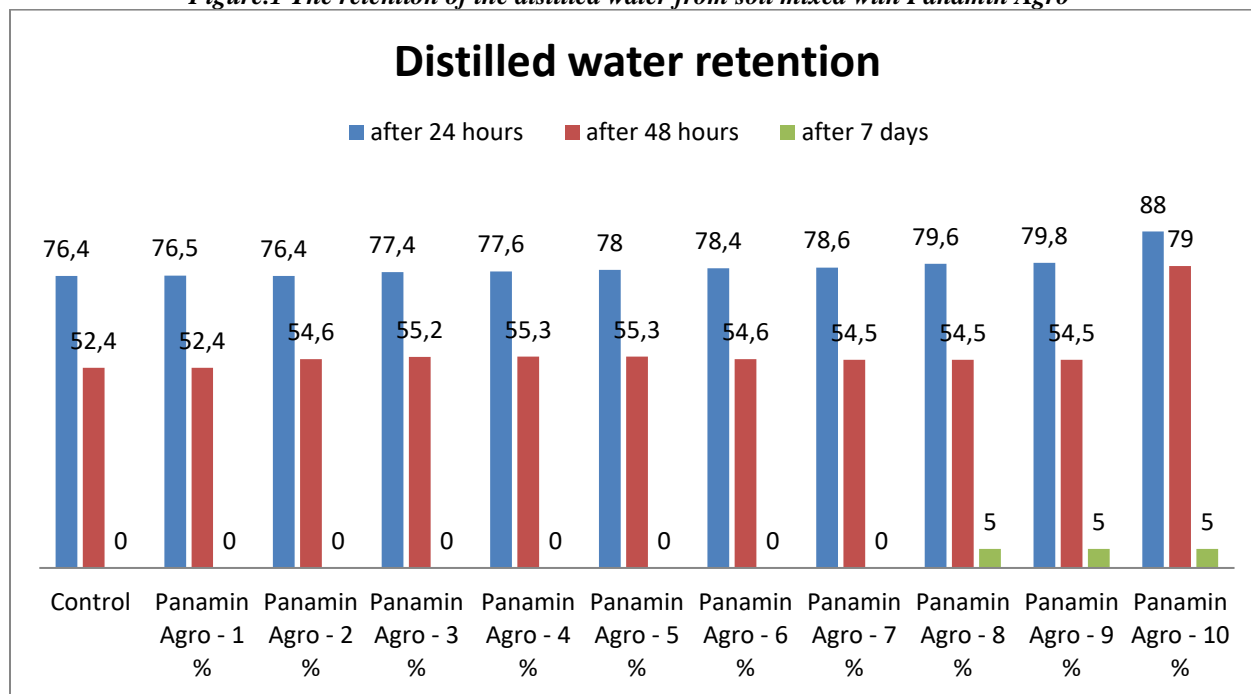
Percent of water in soil = (weight of soil / weight of soil before start of the test)*100

One –way ANOVA statistical analysis was performed with R language for statistical computing for determination of statistically proven differences between test variants (Okoye & Hosseini, 2024)

3. RESULTS

In the Figure 1 below are presented data received with distilled water i.e. distilled water retention from soil amended with the tested rock dust

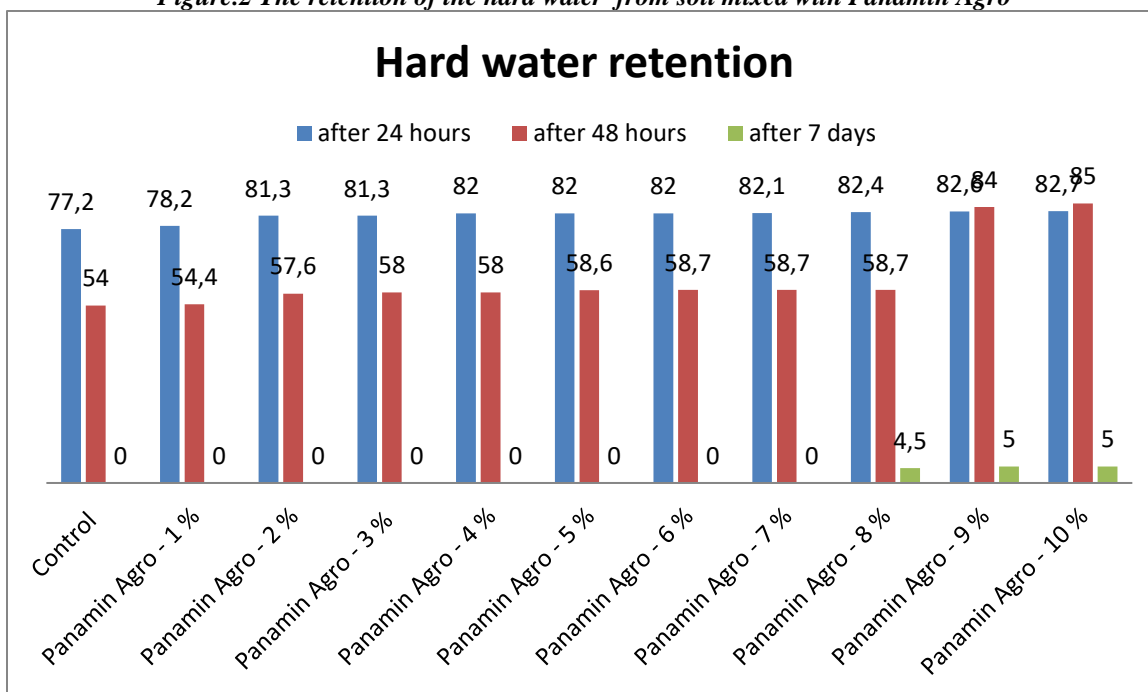
Figure.1 The retention of the distilled water from soil mixed with Panamin Agro



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Data from conducted trials show that the presence of the rock powder in the soil does not affect its water retention ability when is applied up to the 9 % concentration ($p>0.05$). However, then Panamin Agro was 10 % from the mass of the soil, water retention increased by 10 %, 24 hours later and by 45 %, 48 hours after the beginning of the test ($p<0.05$). Seven days after the start of the test there was no water in the soil of the control variant as well as in the soil mixed with Panamin Agro up to the 7 % concentration. When rock dust is from 8 to 10 % of the mass of the soil, 7 days later there is still 5 % water in the soil ($p<0.05$). From Figure. 2 show the results received then hard water (196 ppm CaCO_3) was used instead distilled water.

Figure.2 The retention of the hard water from soil mixed with Panamin Agro



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The results show that there is no difference in the control variant when distilled or hard water is used ($p>0.05$) and when Panamin Agro is only 1 % from the mass of the soil. However, when its concentration increases the retention of the water increases by 7 %, 24 hours later and by 5 % 48 hours after the beginning of the test. Unlike distilled water, when hard water is used Panamin Agro can increase the retention of the water by approximately 5 % towards control variant and variant where is applied at 1 % concentration, 24 hours after start of the test ($p<0.05$). However there were no statistically proven deference between 2 % and higher tested concentration of 10 % , 24 hours after start of the test ($p>0.05$). The same was 48 hours after the beginning of the test except that in 9 % - 10 % concentrations, the tested rock powder was able to increase the water retention of the soil by 45 % ($p<0.05$). Just like distilled water, 7 days after the beginning of the test, there is no water in the control variant and variants when soil is mixed with Panamin Agro up to 7 % concentration. When tested rock powder is from 8 to 10 % of the mass of the soil, 5 % of water was persisted.

4. DISCUSSIONS

Conducted tests show that Panamin Agro can significantly improve the water retention of the soil significantly, but for this, it must be mixed with the soil in relatively high amounts – 80 – 100 grams per kg of soil. When hard water is used, the water retention with Panamin Agro also additionally increases. Even after 7 days, soil amended with Panamin Agro can preserve some of the water in the conducted in vitro tests.

5. CONCLUSIONS

Water hardness does not affect water retention in the soil, but mixing soil with volcanic rock powder which acts as a non – organic fertilizer can also strongly increase its water retention ability. Rock dust actually can contribute to greater water retention when hard water is used than soft water. Improved water retention of the soil can be achieved

when rock powder is used in relatively high doses of 80-100 grams per kg soil or 0.8 - 1 kg Panamin Agro per square meter. However this rock dust is extremely resistant to washing out of soil due to its nature which means that after application Panamin Agro can persist in the soil for several years, which on the other side makes these high doses economically acceptable. The future trials must be conducted to be revealed is this better soil water retention can be achieved only with Panamin Agro or with other products on the base of rock meals or clays.

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