Mulching Effect on Evaporation from the Soil Surface and Water Use Efficiency of Cowpea Crop

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ABSTRACT:

The efficiency of mulching to reduce soil surface evaporation depends on the climate and the characteristics of the different mulching materials. This study aims to investigate the effect of varying mulching materials on soil evaporation, total chlorophyll, growth parameters, leaf area, yield, N, P, and K content in straw and seeds, and water use efficiency of cowpea (*Vigna unguiculata L.*) variety Karim-7 under two soil types with different texture as well as the interaction between them. For this, the pot experiment during the summer of 2021 was conducted at the Soils and Water Department farm, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt. Two types of soil were used: clay and loamy sand. The mulching materials used for the soil's surface were black plastic (T2), white plastic (T3), rice straw 3 (T4), 6 (T5) and 9 cm thickness (T6), gravel 3 (T7), 6 (T8) and 9 cm thickness (T9), in addition to the control treatment (T1: without mulching). In general, mulching materials reduced consumptive use (CU), enhanced growth parameters, and increased the yield of cowpea compared to the control. As a result, using these materials is recommended to prevent water losses by evaporation, conserve soil moisture, and increase the water use efficiency (WUE) of cowpea.

Keywords: Evaporation; different mulching materials; soil types; water use efficiency; and cowpea.

INTRODUCTION:

Cowpea (*Vigna unguiculata L.*), a major grain legume crop grown in semi-arid regions, is an essential vegetable in Egypt. The cowpea grain content is as follows: protein (20–25%), carbohydrate (57%), iron (48.69 mg kg^{-1}), zinc (29.9–41.8 mg kg^{-1}), fat (1.9%), and fiber (6.3%) (Silva et al., 2014) in addition to the essential amino acid lysine (Hafiz and Damarany, 2006). Also, the leaves and fresh pods provide a low-cost source of vitamins and minerals. Therefore, cowpea leaves and green pods are consumed as a vegetable, and the dried grain is used in many different food preparations. Cowpea also plays a vital role in providing soil nitrogen, especially in areas with poor soil fertility (Sheahan, 2012). Its roots have nodules in which soil bacteria called Rhizobia inhabit and help fix nitrogen from the air into the soil. As a result, it can fix 40–80 kg ha^{-1} of atmospheric nitrogen in the soil (Mafakheri et al., 2017).

In water-scarce regions like Egypt, increased agricultural water demand and climate change's projected effects may significantly drop crop output and water productivity (Marwa et al., 2020). Due to the scarcity of irrigation water and reduced precipitation, Egypt's water production is a significant challenge. Hence, according to reports, agriculture is strongly linked to regional water resources, sustainable water management, and local food production (Hozayn et al., 2013). Soil mulching with organic material is one method of preserving soil water. This practice also aids in maintaining a constant soil temperature for plant roots. Plastic mulch use in agriculture can improve plant growth and development and increase vegetable output by improving adjacent plants' heat and moisture (Kosterna, 2014 and Mendonça et al., 2021). Depending on the yield, climate, cost, and benefit, mulching can be done using organic or inorganic materials like straw or plastic film (Wang et al., 2017; Hassan et al., 2014 and Sadeghi et al., 2015). By decreasing the sun's ability to produce heat, the vapor pressure gradient reduces soil evaporation, splitting a more significant portion of moisture into transpiration, increasing nutrient inflow, and increasing yield, as investigated by Bhatt, 2020. It has been proven that mulching fields with rice straw increases sugarcane growth, yield, and quality indices by reducing evaporation. Also, it was shown that maintaining straw mulch for only one year had no meaningful effects on soil quality, as determined (Bhatt, 2021).

Researchers discovered that plastic mulching is more successful at lowering soil evaporation and maintaining soil moisture than straw mulch, in addition to boosting plant height, dry matter weight, and crop quantity. When mulching is absent, sunlight directly hits the soil, turning whatever liquid water into gaseous water, which is then lost to the atmosphere (Mehrazar et al., 2020). The results showed that irrigation at 80% of crop evapotranspiration (ETc) with mulching rates of 12.0- or 7.2-ton ha^{-1} enhanced biological crops, straw, and grain-like irrigation at 100% of ETc with a mulching rate of 7.2-ton ha^{-1}. Irrigation at 100 and 80% of ETc benefited from nitrogen uptake under 12.0- or 7.2-ton ha^{-1} soil mulching. Aside from that, a mulching rate of 2.4-ton ha^{-1} with irrigation at 80 or 100% of ETc generated the soil's highest phosphorus concentration. Also, a mulching rate of 12.0-ton ha^{-1} with irrigation at 80% of ETc demonstrated a continuous rise in water consumption effectiveness throughout the two experimental seasons (Salem et al., 2021). Mulching is an efficient agronomic method to boost water use efficiency, maintain soil moisture, and hasten seedling emergence by 14–32 days compared to treatment without mulching. Dry matter, plant height, and yield also increased (Min Liang et al., 2018). Soil mulching can be used as a more efficient field management strategy to reduce salt evaporation and upward migration. Mulches significantly improve the soil's chemical, physical, and biological properties, and crop productivity. They also offer protection from cold weather and drought stress (Chen et al., 2016).

Franquera, 2015 and El Naim and Jabereldar (2010) They observed that adding organic matter to the soil dramatically reduces the rate of water loss from the soil's surface during evaporation compared to bare soil. Mulching can reduce irrigation water by up to 20% while increasing crop production (El-Metwally et al., 2021). This research aimed to examine how effectively different mulching materials, whether organic materials like rice straw or inorganic materials like plastic and gravel, reduce evaporation from the soil surface, which helps retain soil moisture, and how this impacts the water use efficiency of the cowpea.

MATERIALS AND METHODS

Experimental site and treatments

A pot experiment was carried out at the farm of the Department of Soils and Water, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt. This study investigates how well affecting different mulching materials can reduce soil surface evaporation, such as plastic of two different colors, rice straw, and gravels of various thicknesses. Two different types of soil were used with different texture: clay soil from the El–Sharkia Governorate, El–Zagazig City, and loamy sand soil from the El–Menoufia Governorate, El–Sadat City, from the surface layer (0–30 cm) for both. The soil samples were collected, air-dried, crushed, and sieved through a 2.0 mm sieve. The physical, chemical, and hydro-physical properties of the analyzed soil samples were determined in Tables 1 to 3.

Plastic pots with a diameter of 34 cm and a height of 27 cm were uniformly packed with 20 kg of soil. The cultivated plants were fertilized according to the general recommendations of the Ministry of Agriculture. Four grains of cowpea (*Vigna unguiculata L.*) variety Karim-7 were planted in each pot on the 4th of April during the summer growing season of 2021. After 21 days of planting and an approximate 12 cm height for the plant, the plants were thinned down to two plants in each pot. Three types of mulching were tested in this investigation, as follows:

a. Mulching with plastic: Two plastic colors of 200 mm thick polyethylene mulching were used: black plastic (T2) and white plastic (T3).

b. Mulching with rice straw: Rice straw is 10 cm long and has three thicknesses: rice straw with a 3 cm thickness (T4), rice straw with a 6 cm thickness (T5), and rice straw with a 9 cm thickness (T6).

c. Mulching with gravel: Gravel with a diameter of 8 to 30 mm and three thicknesses were used: gravel with a 3 cm thickness (T7), gravel with a 6 cm thickness (T8), and gravel with a 9 cm thickness (T9). All treatments were compared to the control (T1: without mulching). The treatments were applied to the soil surface surrounding the plants in the pot. The pots were weighed to determine the field capacity for the specific soil types before applying the treatments. Every two days, the pots were weighed to measure how much water evaporated in the morning and how much more water was required to reach field capacity.

On the 15th of August, during the summer of 2021, the plants were harvested once the crop had matured. First, the fresh weight of cowpea was measured as (g pot^{-1}), and the number of branches in each pot was known; they were clipped from above the soil's surface. Then, all the plants in one container were tied off from it. After that, one of them was taken to the lab, where it was utilized with its brushes to dry in the air, separate the pods from the stems, and then weigh and count them. After that, the samples were placed in a 70℃ oven to dry out. Then, they were considered again to determine their dry weight was measured as (g pot^{-1}) after being removed from the oven. Next, the samples were dried and ground in the lab's grinding apparatus. Then, a wet digestion procedure using $HClO_4$ and H_2SO_4 (Jackson, 1973) before being deposited in their plastic packs and preserved for chemical analysis, where they will stay until it is time to estimate their nutrient content.

Analytical methods and measurements

According to Sarkar and Haldar (2005), particle size distribution was measured by the pipette method. Organic matter was determined according to Walkely and Black (Jackson, 1973). Soluble cations and anions were measured in soil water extract (Pansu, 2003). Soil reaction (pH) was measured in 1:2.5 soil water suspension using a pH meter, as reported by (Page et al., 1982). Electrical conductivity (EC: dS m^{-1}) was measured using a digital EC meter. Calcium carbonates were determined as outlined by (Richards, 1954). Leaf area per plant (cm^2); mathematically calculated using leaf area- leaf weight relationship from leaf disks obtained by a cork borer according to Wallace and Munger, 1965. Total chlorophyll was measured in the plant samples as a Spad value (Minolta, 1989). Nitrogen, phosphorus, and potassium were determined according to (Jackson, 1973). Consumptive use (CU) was measured for all treatments by the weight of the pots with a calculation of the amount of water added to reach the field capacity of the soil. Finally, the following computation was used by (Giriappa, 1983) to evaluate water use efficiency (WUE) in kg m^{-3}.

$$WUE = \frac{\text{Seed yield (kg pot}^{-1}\text{)}}{\text{Crop consumptive use (m}^{3}\text{ pot}^{-1}\text{)}}$$

Where:

WUE = Water use efficiency (kg m^{-3}).

Statistical Analysis

The dataset of studied characters was collected and subjected to univariate statistical analysis. The analysis of variance (ANOVA) based on a completely randomized design with six replicates was performed according to Gomez and Gomez (1984) using the XLSTAT statistical package. Duncan's multiple range test was used to make a means comparison of treatments.

RESULTS AND DISCUSSION

Effect of mulching and soil types on total chlorophyll, number of branches, and leaf area of cowpea

The findings in Fig. 1 demonstrate how mulching and soil types affect total chlorophyll as a Spad value. The outcomes showed no distinction between the two soil types regarding how they affected total chlorophyll. Regarding the effect of the first factor, the different mulching materials, the results showed that treatment T3 fared better than the other treatments, particularly the control T1, which recorded the lowest value of 38.40 Spad. In comparison, treatment T3 recorded a value of 61.48 Spad. As for the effect of the second factor, the soil types, on the total chlorophyll value, the results showed no significant differences between the two soils.

Concerning the impact of the interaction between different mulching materials and soil types, it was discovered that the treatment T3 with loamy sand soil performed better than the other treatments, recording a value of 65.63 Spad, compared to the control (T1), which recorded the lowest value of 26.74 Spad. When comparing the soil types and their impact on branch counts, clay soil performed better, with a value of 16.44. While the loamy sand soil recorded the lowest value of 7.81, indicating a considerable difference between the two soil types and their impact on branch numbers. There were no significant differences between the treatments from T4 to T9. The T7 treatment recorded the highest value when comparing the types of mulching and their effects on the number of branches, with a value of 13.83. On the other hand, the T1 treatment had the lowest value of 8.33. As was noted, the T5 treatment with clay soil of the two soil types outperformed the other treatments when comparing the interaction between different mulching materials and the soil types, with a value of 19.00.

On the other hand, the control treatment (T1) with loamy sand soil recorded the lowest number of branches with a value of 2.67, indicating the presence of statistically significant variations for the types of mulching applied to the soil and their impact on the number of branches. The rise in the number of branches may be attributable to the plants' improved growth because of the soil's optimal hydrothermal regime and the availability of moisture, which increases nutrient absorption and promotes the plant's healthy growth and development. There were no significant differences between the soil types regarding the effect of mulching on the leaf area. Still, when the mulching differed, treatment T5 recorded the best value and treatment T1 the lowest value (49.49 and 23.84 cm^2, respectively). The T5 treatment with clay soil recorded the highest value (49.99 cm^2) when comparing the impact of the interaction between the soil types with the different mulching materials. In comparison, the treatment T1 recorded the lowest value of 22.51 (cm^2). These findings corroborated those by Bhagat et al. (2016) and Bhardwaj (2011).

Effect of mulching and soil types on the number of pods and fresh and dry weight of cowpea

In Fig. 2, statistics are displayed on the number of pods per pot produced, the fresh and dry weight of straw, and the impact of mulching on these traits during the growing season. Regarding the number of pods per pot, the results indicated that clay soil outperformed loamy sandy soil in terms of the number of pods recorded (28.96 and 11.26, respectively). Regarding the effect of different mulching materials, it was discovered that the T3 treatment performed better than the other treatments regarding the number of pods compared to the T1 treatment, which recorded the lowest value (24.50 and 14.67, respectively). Concerning the impact of the interaction between different mulching materials with soil types, the treatment without mulching (T1) recorded the lowest number of pods per pot for loamy sandy soil, which is (5.00), compared to other treatments. On the other hand, the treatment T3 with clay soil performed better than the other treatments for clay soils and was recorded with a value of 37.33. While comparing the two soils for fresh weight, the findings revealed that the clay soil was superior to the loamy sand soil and that there was a considerable difference between the two soils, with the clay soil having the highest value of 97.96 (g pot^{-1}), while the loamy sand soil had the lowest value of 38.46 (g pot^{-1}). In addition, the T4 treatment was found to be superior to the other treatments in fresh weight recorded (142.45 g pot^{-1}) compared to the control (T1), which recorded the lowest value (80.28 g pot^{-1}) when studying the effect of the different mulching materials on fresh weight. Significant differences existed between the treatments when comparing the impact of the interaction between the soil types with the different mulching materials was studied. It was discovered that the clay soil outperformed the loamy sand soil in all treatments. This outcome is consistent with Mamkagh (2009) and Mahadeen (2014). Furthermore, it was discovered that there is a considerable difference between the two soils in terms of their dry weights, with the clay soil being superior to the loamy sand soil, where the values of clay soil and loamy sand soil are 44.97 and 8.87 (g pot^{-1}), respectively. Treatment T4, which recorded the highest dry weight, outperformed the other treatments when comparing the types of mulching and their impact on the dry weight (31.75 g pot^{-1}). Conversely, treatment T1 reported the lowest value (18.54 g pot^{-1}). The treatments T3 and T5 with clay soil were superior to the other loamy sand soil, as they recorded (50.40 and 50.03 g pot^{-1}), respectively, and the lowest dry weight recorded was the control treatment with loamy sand soil (2.19 g pot^{-1}) when studying the effect of the different mulching materials and soil types on the dry weight, this shows that the impact of the interaction between different mulching materials and soil types causes significant differences in the dry weight of cowpea. These findings agree with those of other authors, including Rashidi et al. (2010), Parmar et al. (2013), and Humaiza et al. (2022).

Effect of mulching and soil types on N, P, and K content in both straw and seeds of cowpea

The results are displayed in Figures 3 and 4, showing the effect of different mulching materials and soil types on N, P, and K content in cowpea straw and seeds. Comparing the soil types based on the nitrogen content of straw reveals that the clay soil has a greater level than the loamy sand soil and that there is a substantial difference between the two soils. The clay soil had the highest value of 2.34%, while the loamy sand soil had the lowest value of 1.15%. The T2 treatment outperformed the other mulching treatments in the concentration of N (2.31%) compared to the control, which recorded the lowest value (0.98%), and it was discovered that there were significant differences between the treatments when the different mulching materials were compared to one another. The clay soil was superior with treatment T2 over the other loamy sand soil, with a value of 3.13%, while the control treatment (T1) with loamy sand soil recorded the lowest value, with a value of 0.56%; this was determined by an interaction between both mulching and soil types. It's possible that mulching decreased soil nitrogen loss and microorganism nitrogen fixation or that mulching, and straw boosted organic nitrogen mineralization in the soil, explaining the rise in plant nitrogen intake. These findings agree with Gao et al. (2009) and Chakraborty et al. (2010). Regarding the phosphorus content of the straw in the two soils, it was discovered that the clay soil had a higher phosphorus content with a value of 0.47% than the loamy sand soil, with a value of 0.41%, and that there was a substantial difference between the two soils. There were no statistically significant differences between treatments when evaluating the different materials of mulching and their impact on phosphorus content. However, the T2 treatment with clay soil was preferable to the other treatments when comparing the different forms of mulching with the soil types, recording the highest value for the other treatments in the two soils (0.54%). At the same time, treatment T3 with loamy sand soil showed the lowest recorded phosphorus concentration (0.38%), which revealed significant differences for different materials of mulching and soil types and their impact on the phosphorus content in the straw of cowpea. These results agreed with those obtained by Liu et al. (2021) and Chai et al. (2022). The results showed substantial differences in potassium content between the clay soil and the loamy sand soil, with the clay soil having the best potassium concentration (3.93 %). The T9 mulching treatment recorded the highest value for the potassium content compared to the control, which recorded the lowest value (2.81 and 2.32%), respectively. The treatments significantly differed when comparing the different mulching materials and soil types. And it was discovered that the clay soil performed better with the T9 treatment than the loamy sand soil, which is 4.44%. In contrast, the control treatment T1 in loamy sand soil recorded the lowest potassium content value (0.95%) when the different mulching materials were compared with the soil types. These results are in harmony with those obtained by Yan et al. (2019) and Salem et al. (2021). According to the results of comparing the two soils, the clay soil has a higher nitrogen concentration in the seeds than the loamy sand soil (2.44 and 2.09%), respectively. The T3 treatment of nitrogen concentration in the seeds fared better than the other treatments when compared to the control (T1), which recorded the lowest value (3.10 and 1.14%), respectively, when the different mulching materials were contrasted with one another. The loamy sand soil with treatment T3 outperformed the other treatments in the two soils when comparing soil types and mulching on nitrogen concentration in the seeds (3.17%). At the same time, the lowest value (0.89%) was achieved by the control treatment T1 with loamy sand soil. It was discovered that there is no discernible difference between the two soils in terms of the phosphorus content of the seeds. When comparing the different mulching materials, the T2 treatment had the highest phosphorus value (0.55%) compared to the treatment without mulching (T1), which had the lowest value (0.39%). The clay soil treatment T2 outperformed the other treatments, recording the highest value for the treatments in the two soils compared to the treatment T1, which recorded the lowest concentration (0.59 and 0.38%, respectively), indicating significant differences between soil types and different mulching materials and their effects on seed phosphorus concentration. Regarding potassium, the results showed substantial differences between the clay soil and the loamy sand soil, with the clay soil having the best K concentration with a value of 3.95 %. The T4 treatment had the highest value for the treatments compared to the control, which recorded the lowest value (4.96 and 3.42%), respectively, when the different mulching materials were compared. The clay soil was superior with treatment T2 over the other treatments in the two soils recorded (5.37%), compared to the control treatment (T1) with loamy sand soil with a lower value in potassium concentration, which is (2.32%) when comparing the different mulching materials by soil types. The increase in nutrients and their concentration in the seeds is probably primarily attributable to increased plant biomass from different mulching materials, which alters the soil's capacity to hold moisture and raises nutrient availability. These results were observed by Zhang et al. (2021) and Chai et al. (2022).

Effect of mulching and soil types on seeds weight, consumptive use (CU), and water use efficiency (WUE) of cowpea

The results in Fig. 5 showed how different mulching materials and soil types affect seeds' weight, consumptive use, and water use efficiency of cowpea. Regarding the weight of the seeds, it was discovered that there is a considerable difference between the two soils and that the clay soil is superior to the loamy sand soil in terms of the weight of the seeds, as it was recorded (33.65 and 17.07 g pot^{-1}, respectively). While T8 treatment, which recorded the highest seeds weight, surpassed the other treatments when it came to comparing the different methods of mulching and their impact on the weight of seeds (38.15

g pot^{-1}), compared to the treatment T1, which had the lowest value (14.76 g pot^{-1}). Also, there is a significant difference between the treatments. However, when comparing the soil types with different mulching materials, the treatment T7 with clay soil was superior to other treatments, as recorded (46.60 g pot^{-1}). Also, there were no significant differences between treatment T7 and treatments T3, T8, and T9, where the values were 32.53, 45.33, and 35.27 (g pot^{-1}), respectively. On the other hand, the lowest seeds weight recorded was for the control treatment with loamy sand, as recorded (2.20 g pot^{-1}). This indicates that there are statistically significant differences between the soil types and different mulching materials and their impact on the weight of the seeds of cowpea. These findings concur with those of Yang et al. (2020), Mendonça et al. (2021), and Hatamman and Abdullah (2021). It was discovered that there is a significant difference between the clay soil and the loamy sand soil. In contrast, the clay soil recorded a higher value than the loamy sand soil regarding the effect of the soil types on the amount of water added to the plant; the values were as follows: 0.103 and 0.075 (m3 pot^{-1}), respectively. There were significant differences between the treatments and an increase in the amount of soil surface evaporation. When the different mulching materials were compared, treatment T1 recorded the highest value compared to treatment T3, which recorded the lowest value; their respective values were (0.096 and 0.084 m3 pot^{-1}). There is a noticeable difference between the treatments, with treatment T1 with clay soil recording the most significant value compared to the other treatments (0.111 m3 pot^{-1}) and treatment T2 recording the lowest value in the amount of water provided (0.071 m3 pot^{-1}) with loamy sand soil. From the results in Fig. 5, there is a substantial difference between clay soil and loamy sand soil regarding water use efficiency, with clay soil doing better than loamy sand soil (0.33 and 0.23 kg m^{-3}), respectively. When comparing different mulching materials, the lowest result in water use efficiency was reported by treatment T1 (0.14 kg m^{-3}), whereas the T8 treatment recorded a value of (0.44 kg m^{-3}), indicating a substantial difference between the treatments. The treatment T8 with clay soil recorded the most significant value when compared to the other treatments, which is (0.47 kg m^{-3}) according to the interaction of the soil types with different mulching materials on water use efficiency. While the treatment T1 with loamy sand soil recorded the lowest value of water use efficiency (0.03 kg m^{-3}). The lack of pores in plastic, as well as the greater soil temperature and less moisture loss by evaporation from the surface, especially white plastic, which can reflect light, may be to blame for the increase in water use efficiency. This was supported by Mehrazar et al. (2020), Liu et al. (2021), and Malik et al. (2018).

CONCLUSION:

Mulching with organic materials like rice straw or inorganic ones like plastic and gravel increases the total chlorophyll, growth parameters, leaf area, yield, N, P, and K content in straw and seeds, and water use efficiency. On the contrary, it decreases the water consumption of cowpea. Consequently, mulching effectively conserves soil moisture and prevents water losses by evaporation, improving the cowpea crop's yield and water use efficiency.

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Table 1: Physical properties of the studied soils

Soil location	Particle size distribution (%): Coarse sand	Fine sand	Silt	Clay	Texture class	O.M (%)	B.D (Mg m^{-3})	T.P (%)	$CaCO_3$ (%)	CEC (cmolc kg^{-1})
El-Zagazig	5.50	7.00	31.18	56.32	Clay	1.23	1.40	47.17	2.94	49.80
El-Sadat	48.63	32.60	13.14	5.63	Loamy sand	0.72	1.70	35.85	1.68	5.66

O.M: Organic matter; B.D: bulk density; T.P: total porosity and CEC: cation exchange capacity.

Table 2: Chemical properties of the studied soils

Soil location	pH	EC (dS m^{-1})	Soluble cations (mmolc L^{-1}):				Soluble anions (mmolc L^{-1}):			
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
El-Zagazig	8.10	0.80	1.4	0.60	4.36	1.64	0.00	4.75	1.90	1.35
El-Sadat	7.86	1.19	2.8	1.5	6.76	0.82	0.00	3.30	2.50	6.08

pH (1:2.5) soil water suspension and EC: dS m^{-1} (Soil paste extract).

Table 3: Hydro-physical properties of the studied soils

Soil location	Water holding capacity (%)	Field capacity (%)	Permanent wilting point (%)	Available water (%)	Hydraulic conductivity (m day^{-1})
El-Zagazig	64.00	40.00	19.00	21.00	4.54
El-Sadat	18.60	9.00	4.00	5.00	14.10

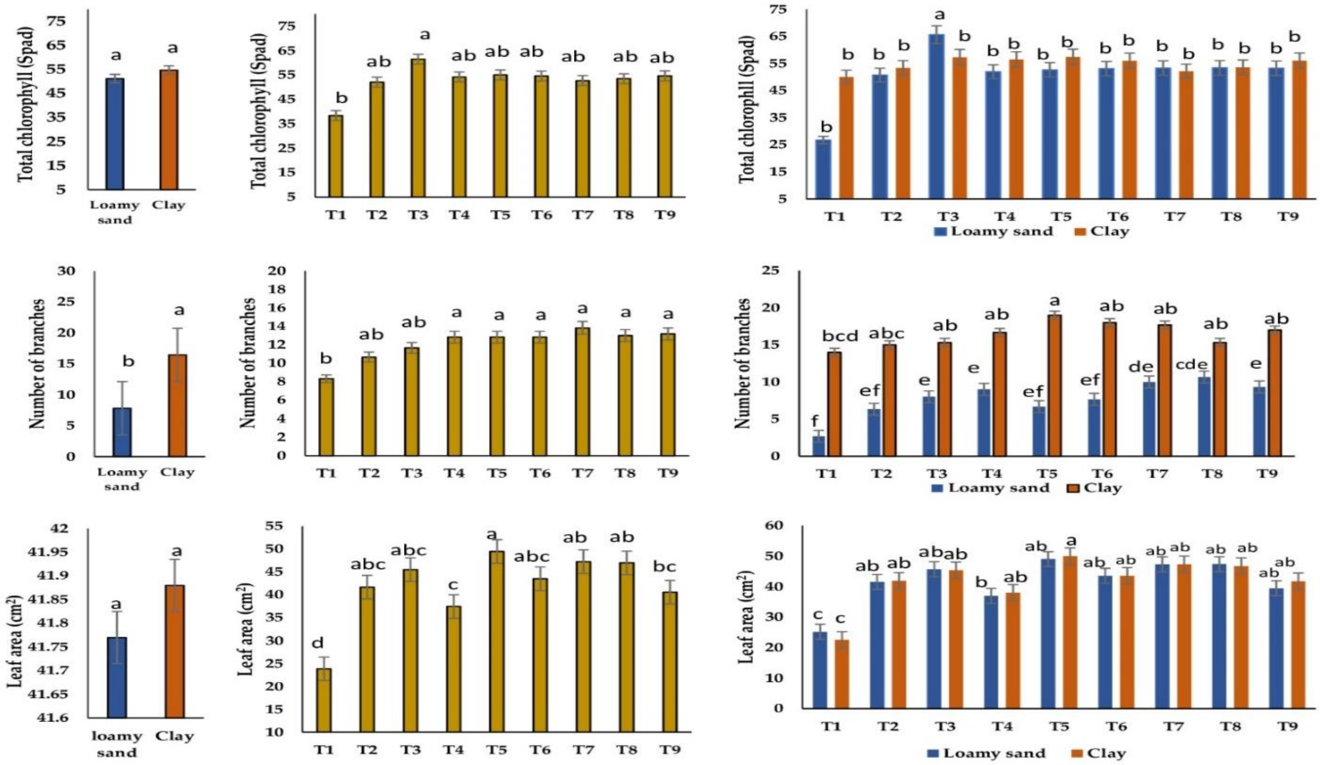

Figure 1: Effect of mulching and soil types on total chlorophyll (Spad), number of branches, and leaf area (cm^2) of cowpea. T1: control; T2: black plastic; T3: white plastic; T4: rice straw 3 cm; T5: rice straw 6 cm; T6: rice straw 9 cm; T7: gravel 3 cm; T8: gravel 6 cm and T9: gravel 9 cm.

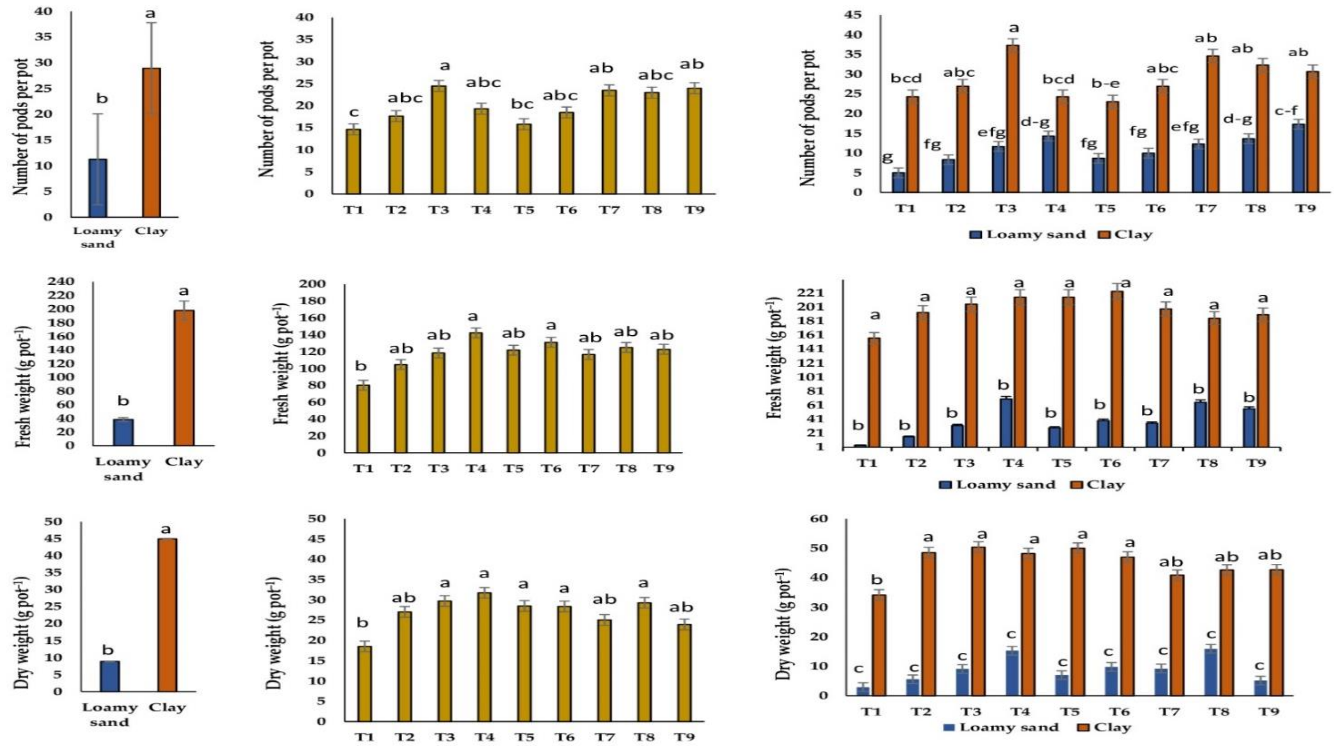

Figure 2: Effect of mulching and soil types on the number of pods and fresh and dry weight (g pot^{-1}) of cowpea. T1: control; T2: black plastic; T3: white plastic; T4: rice straw 3 cm; T5: rice straw 6 cm; T6: rice straw 9 cm; T7: gravel 3 cm; T8: gravel 6 cm and T9: gravel 9 cm

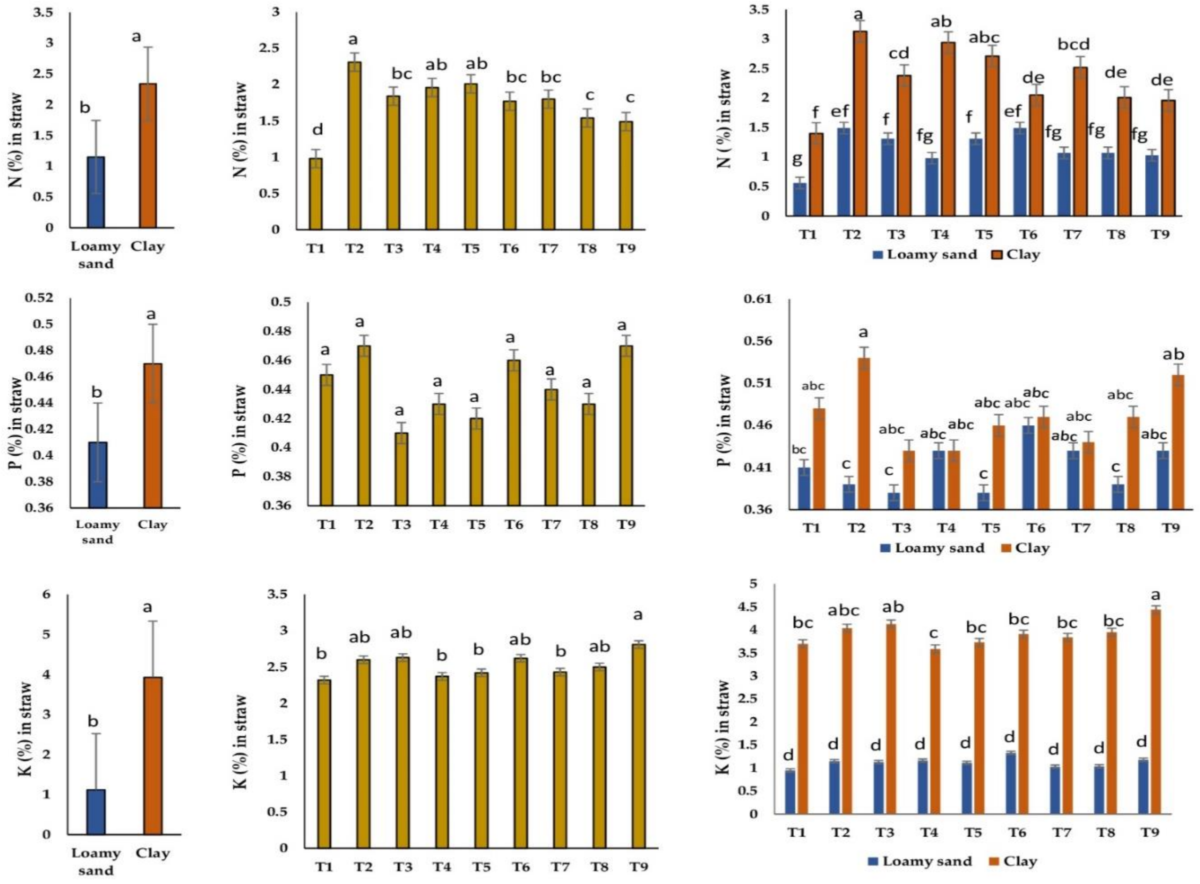

Figure 3: Effect of mulching and soil types on N, P, and K content in straw of cowpea. T1: control; T2: black plastic; T3: white plastic; T4: rice straw 3 cm; T5: rice straw 6 cm; T6: rice straw 9 cm; T7: gravel 3 cm; T8: gravel 6 cm and T9: gravel 9 cm

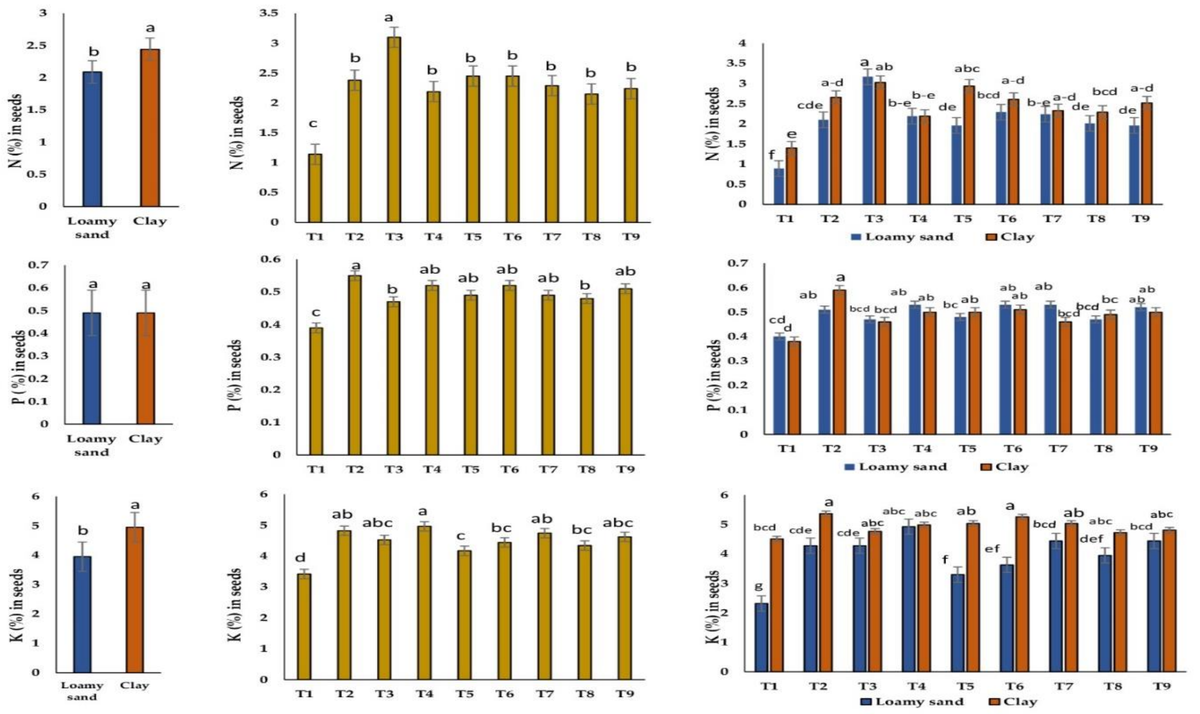

Figure 4: Effect of mulching and soil types on N, P, and K content in seeds of cowpea. T1: control; T2: black plastic; T3: white plastic; T4: rice straw 3 cm; T5: rice straw 6 cm; T6: rice straw 9 cm; T7: gravel 3 cm; T8: gravel 6 cm and T9: gravel 9 cm

تأثير التغطية على البخر من سطح التربة وكفاءة استخدام المياه لمحصول اللوبيا

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الملخص العربي:

تعتمد كفاءة التغطية لتقليل البخرمن سطح التربة على المناخ وخصائص مواد التغطية المختلفة. تهدف هذه الدراسة إلى معرفة تأثير مواد التغطية المختلفة على البخر من التربة، الكلوروفيل الكلى، صفات النمو، مساحة سطح الورقة، المحصول، محتوى القش والحبوب من النيتروجين والفوسفور والبوتاسيوم وكفاءة استخدام المياه لنباتات اللوبيا صنف كريم-7 تحت نوعين من التربة ذات قوام مختلف والتفاعل بينهما. لهذا، أجريت تجربة أصص خلال موسم صيف 2021م في مزرعة قسم الأراضي والمياه بكلية الزراعة، جامعة الأزهر، القاهرة، مصر. تم استخدام نوعين مختلفين من التربة: طينية ورملية طميية. كانت مواد التغطية المستخدمة على سطح التربة هي البلاستيك الأسود، البلاستيك الأبيض، قش الأرز بسمك 6،3 و9سم وكذلك الحصى بسمك 3 ،6 و9سم بالإضافة إلى معاملة الكنترول (بدون تغطية). بوجه عام، قللت مواد التغطية من الاستهلاك المائي، حسنت من صفات النمو وزاد محصول اللوبيا مقارنة بالكنترول (بدون تغطية). لذا، توصى الدراسة باستخدام هذه المواد لمنع فقد المياه عن طريق البخر، الحفاظ على رطوبة التربة وزيادة كفاءة استخدام المياه لنباتات اللوبيا.

الكلمات الاسترشادية : البخر، مواد التغطية المختلفة، أنواع التربة، كفاءة استخدام المياه واللوبيا.