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The Influence of Mulching on the Physical Properties of Agricultural Environment

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ABSTRACT

The wide use of mulch by the agricultural system in most parts of the world and with multiple applications, is necessary to improve our knowledge of the effects of mulching on soil physical properties. Thus, this review a critically explains the mechanism of this application. Generally, it affects a field's energy balance by changing the surface radiation budget, by modifying the albedo of the soil surface or shading the soil surface. This has an effect on net radiation. The effect of mulching on evaporation is that it breaks up capillary diffusion and this depends on the type of mulch. Mulching also affects soil water content and soil temperature, the extent to which depends on the type and thickness of the mulch, the soil texture type and climatic conditions. Several studies have reported that the influence of mulching on greenhouse gas emissions is unclear.

Keywords: Mulch, agricultural environment, physical properties, Soil Temperature, Soil Water content

INTRODUCTION

Since the end of the 17th century, the covering of soil has been known as an agricultural process to improve plant growth and increase productivity; this agricultural practice is called mulching. Mulches improve growth of plants through moisture conservation of soil and enhance physical and other characteristics of the soil. Different types of mulches (color and thickness) may not have the same effect on these properties, under irrigation. Diverse materials were used to cover the soil surface such as plant residues, sawdust, sand, gravel, plastic, etc.… There are several reasons for applying such materials, namely: to control soil temperature, to prevent soil erosion and to reduce the loss of soil water. The causes vary depending on the climatic condition. Usually, in dry areas where the annual rainfall rate decreases and evaporation rates increase (especially in arid and semiarid areas), the focus is on soil water conservation, but the focus in sub-humid areas is on controlling the soil temperature. The choice of mulch type depends on the prevalent climate. Different types of mulch are capable of affecting the physical properties of the soil through hydrological processes such as rainfall interception, infiltration, evaporation and dew deposition, in addition to the heat transfer of the soil. The combined effects of applying a mulch are complex and cannot be predicted in a straight forward fashion. This review article gives more background information on the present topic of study.

Impact of mulching on greenhouse gases

According to IPCC (2014), 10 to 12 % of greenhouse gas emissions in the world are from the agricultural sector. Many contradictory results about the effect of mulching on greenhouse gas emissions, using the mulch can change soil physical properties which leads to impact on greenhouse gas emissions (Smith *et al*., 2008; Berger *et al*., 2013; Liu *et al*., 2014), and the decomposition of organic mulch may increase the availability of N and C which tended to increase CO_2 emissions (Bavin *et al*., 2009; Lenka and Lal, 2013; Chen *et al*., 2017) or decreased CO_2, N_2O and CH_4 emissions (Smith *et al*., 2008; Ahmad *et al*., 2009; Jarecki *et al*., 2009; Yagioka *et al*., 2015). Several results have shown that mulching with inorganics like plastic film decreased CO_2 emissions (Okuda *et al*., 2007; Li *et al*., 2012) or increased CO_2 emissions (Chen et al., 2017), increased CH_4 absorption (Li *et al*., 2014; Cuello *et al*., 2015), and increased N_2O emissions (Arriaga *et al*., 2011; Nishimura *et al*., 2012; Cuello *et al*., 2015) or decreased (Berger *et al*., 2013; Li *et al*., 2014; Liu *et al*., 2014). Several researchers have reported that there is no more difference in soil organic carbon between plastic mulch treatments compared to bare soil (Liu *et al.*, 2014; Luo *et al.*, 2015a, 2015b). With a long term field experiment, Zhang *et al*. (2017) reported that the biomass was higher under plastic mulch than without mulching. However, the average soil organic carbon storage was not significantly different between the two treatments. Over a long term and on large scale, Zhang *et al*. (2017) explained that

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the high biomass under plastic mulch produced more carbon and impact on soil organic carbon balance. On the other hand, some studies have confirmed that there is no significant difference in soil organic carbon between soil under plastic mulch and without mulch (Liu *et al*., 2014b; Luo *et al*., 2015; Wang *et al*., 2016).

Change energy budget under mulching applies

Mulching influences the microclimate of a field by affecting the radiation budget over the surface, because the surface energy balance is altered by the mulch (Lei *et al*., 2004; Allen *et al.*, 1998; Ding *et al.*, 2013). For example, Price *et al.* (1998) found that the available energy over bare soil was higher than that recorded over covered soil by straw mulch. This is because straw mulch has a significantly higher albedo than bare soil, and the net radiation was 15% lower over straw mulch compared to that over bare soil. When using 2-3 cm thick concrete as mulch above the soil around trees, the net radiation over the concrete mulch was lower than at the bare soil (Lei *et al*., 2004). This can be attributed to the fact that more short wave radiations are reflected by concrete, the albedo of a concrete is higher compared to bare soil. It was ranged between 0.25 - 0.28 and 0.13 - 0.16 for concrete mulch and wet soil, respectively. The albedo values of a dry soil were close to those of concrete (Ten Berge, 1986). Kemper *et al.* (1994) found that the color of the sand and gravel mulched on the soil surface resulted in decreased evaporation; red sand stone and gray granite mulch allowed more water to be lost than white color such as feldspar and quartz mulch. There was a higher loss of water in the first stage of evaporation due to a decrease in albedo (Jalota *et al.*, 2001).

However, a black plastic mulch absorbs wavelengths of incoming solar radiation between ultraviolet visible to infrared wavelengths. Hence, most of the solar energy absorbed by black plastic mulch is lost to the atmosphere through long wave radiation (Anikwe *et al*., 2007). During the day, incoming solar radiation is absorbed in the upper 20% over the straw mulch, than is dissipated as sensible heat into the atmosphere (Novak *et al*., 2000). The net radiation was 17% higher over bare soil in the semi-arid area, but was only 1% higher in arid areas compared to mulch soil (Stroosnijder et al., 2012). On the other hand, the albedo increased by using white or clear color for thin plastic mulch and this affects the energy balance at the soil surface (Ding *et al*., 2013). Fan *et al*.(2017) published that the plastic mulch decreased net radiation and increased soil heat flux; in addition, the daily net radiation was lower for mulch treatment compared to bare soil. Regarding the available energy, the average daytime latent heat flux during experimentation in semi-arid area consumed 75% more energy than bare soil compared to 59% over mulched soil. In arid area experiment, this flux consumed only 30.1% over bare and 6.1% over mulched soil, of the available energy (Stroosnijder et al., 2012).

Shiina *et al.* (1999) reported that there was an increase in the sensible heat flux value over polyethylene film mulch compared to that above bare soil in the daytime. Also, the air temperature over polyethylene film mulch was higher than that above bare soil in the daytime while the specific humidity over polyethylene mulched soil was lower than that above bare soil. The average sensible heat flux was higher over the mulch than bare soil (Stroosnijder et al., 2012). Price *et al.* (1998) confirmed that the relative humidity beneath straw mulch was 10-15% higher than that above the bare soil around noon.

Mulching alters the soil heat flux, Lei *et al.* (2004) reported that when they used concrete above soil, the soil heat flux below a concrete mulch could be significantly higher than the soil heat flux for a bare soil at high soil moisture contents during daytime. However, soil heat flux was found to be greater in bare soil compared to soil under straw mulch. The soil heat flux below straw mulch was only 13% of the bare soil value and was decoupled from the daily net radiation (Price *et al.*, 1998).

Nachtergaele *et al*. (1998) reported that gravel mulch affects aerodynamic resistance, and causes an enhanced turbulent transport of water vapor and sensible heat, due to the relatively large length of rough material such as gravel. Also, mulching the soil surface with plant residues may affect aerodynamic resistance (Xie *et al*., 2005), generally causing it to decrease.

Influence of mulching on soil water evaporation

There are three requirements for evaporation to occur, firstly: available energy to supply the latent heat of vaporization, secondly: a sustained difference in vapor pressure was recorded between the atmosphere and the air in the pores near the soil surface. It is important that vapor pressure at the soil surface is higher than in the atmosphere. Thirdly: the process of evaporation requires a supply of water to the evaporation front. Evaporation from bare soil occurs in three stages. The first stage is "the constant rate stage" which is controlled solely by meteorological conditions. The second stage is "the falling rate stage", during which the soil hydraulic properties, as well as the meteorological conditions, are in control of the evaporation rate. Finally, there is "the slow rate stage", which may persist at a nearly steady rate for many days or weeks, depending on the soil texture.

Hillel (2004) published that evaporation from bare soil can be modified by: 1) changing the energy supply to the surface, for example by changing the albedo of the soil surface, or by covering the soil surface; 2) reducing the potential gradient or the force driving water upward through the soil profile; 3) decreasing the hydraulic conductivity or diffusivity of the soil profile. The soil evaporating front occurred between 5-10 cm soil depth, and water vapor occurred in 0-5 cm layer, before diffusing to the atmosphere (Wu *et al*., 2017).

Water moves from the soil surface to the mulch surface mostly in the vapor phase, because the mulch on the soil surface decreases capillary diffusion, during the first stage of evaporation (Li, 2003). Moreover, the mulch reduces soil water evaporation by shading the soil surface and the most operative during the first stage of evaporation (Tolk *et al.,* 1999). The cumulative evaporation from mulched soil was delayed compared to soil without much, during the first stage of evaporation. Furthermore, there was a decrease in cumulative evaporation and the surface soil layer under a mulch remained moist for a longer period, under a reduced rate of evaporation by mulching (Gill and Jalota, 1996).

Naturally, during soil drying without mulching, water moves only in the vapor phase because the soil develops a natural dry layer at the surface to save water under the soil surface (Yamanaka *et al*., 2004). This process occurs mostly for soil with coarse texture.

The impact of mulching on evaporation from soil surface depends on the type of mulch. For example, evaporation from soil surface under gravel mulch and without mulch treatments was higher compared to film mulch treatment (Xie *et al.,* 2005). Several studies have confirmed that plastic mulch reduces evaporation from the soil surface compared to evaporation from a bare soil surface (Maged, 2006; Han *et al*., 2015; Liu *et al.*, 2014; Wang *et al*., 2016). Plastic mulching could reduce soil evaporation, especially by using drip irrigation (Zheng *et al.,* 2017).

In the laboratory, many researchers have investigated the effect of gravel mulch on cumulative evaporation rate from the soil surface (Mellouli *et al.*, 2000; van Wesemael *et al.,* 1996; Groenevelt *et al.*, 1989; Modaihsh *et al.*, 1985).Using gravels above the soil surface or coarse sand can reduce evaporation rate by 10-20 % of that emanating from the bare soil surface (Fang *et al.*, 1993; Unger, 1971; Lemon, 1956). This is because gravel mulch limits the area of the soil surface available for evaporation (Nachtergaele *et al.*, 1998).

Li (2003) investigated the influence of gravel mulch on the three stages of evaporation, after 14 days, the cumulative evaporation for the bare soil was 13.3 mm, which was four times that of the gravel mulch. The first stage concerned the rapid and more or less constant rates of water loss over the first 3 days; the second stage recorded a decrease in the evaporation rate, over the next 6 days, whereas after about 9 days the third stage started, when the evaporation rates were slow. The average evaporation rate for the pure gravel and pure sand mulch was 1.6 and 2.5 times higher, respectively, than that for uniformly mixed gravel and sand mulch, 2.6 and 1.6 times lower than that for the bare soil (Li, 2003). The amount of evaporation from the soil surface increased linearly with gravel size (Xie *et al.*, 2006). Corey and Kemper (1968) found that the grain size of the gravel mulch layer should be significantly larger in relation to the texture of the underlying soil; evaporation would be reduced only if the gravel particles are bigger than the grains of the soil beneath.

There was a slight decrease in evaporation when the soil moisture was reduced from 27 to 8%, with a gravel mulch on the soil (Xie *et al.*, 2006). Furthermore, the gravel mulch did not have an impact on the cumulative evaporation depth after 46 days (Mellouli *et al.*, 2000). Nachtergaele *et al.* (1998) noted that after 46 days, the gravel mulch increased the evaporation rate compared to bare soil. This was because the size of the mulch material used in that study was relatively small, evaporation could have occurred through gaps in the mulch layer, and the relatively high temperature of the mulch could have enhanced the evaporation (Lei *et al.*, 2004). Generally, the evaporation rate may be lower in the bare soil compared to a soil surface covered by mulch during the second stage, but water losses in the first stage are always greater for the bare soil (Kamar, 1994; van Wesemael *et al.*, 1996; Stroosnijder et al., 2012).

Many types of organic mulch reduce evaporation during the first stage, but are not necessarily effective during the second stage. For example, Mellouli *et al.* (2000) found that the application of straw is very efficient in the first stage of evaporation from bare soil, but has no effect in the second stage. Application of olive mill effluent on the soil surface is more efficient in reducing evaporation losses and affects both the first and second stages of evaporation. The wheat straw mulch reduced evaporation by 50% in winter (Wang *et al.*, 2001). Shangning and Unger (2001) found that the greatest reductions in evaporation due to wheat straw mulch occurred during the first stage of evaporation, because the straw mulch cut off the liquid water supply to the soil surface by disrupting the upward capillary flow (Gill and Jalota, 1996). Soil coverage with organic mulches is one of the natural methods and it can be achieved by using plant mulches and mulches from straw left after cereal harvest (Liebman and Davis 2000; Kosterna, 2014; Saad, 2017). Zagaroza (2003) showed that the mulch performance was depended on its thickness on the soil surface. Ground Cover Rice Production System (GCRPS) for saving irrigation water was assessed compared to Paddy control (lowland rice cultivated under traditional paddy conditions), only 32-54% of irrigation applied in water was in GCRPS treatments where the soil surface was covered with 14 mm thick plastic film or mulched with straw (HongbinTao, et al 2006). Rice straw mulch lowered cumulative evaporation from clay loam soil over the crop growth season of wheat by 35 and 40 mm in relatively high and low rainfall years, respectively (Singh et al 2011). There was a significant effect as a result of applied different rates of rice straw (thickness of the layer), the applied methods of rice straw and the sand particles percentage with size less than 250 µm on accumulation evaporation of the two sandy soils subjected to successive drying and wetting cycles (Saad, 2018). However, after 46 days from the first day of evaporation, the straw mulch did not have any impact on the cumulative evaporation. However, the amount or thickness of residue, together with potential evaporation rate, determines the rate of drying (Tolk *et al.*, 1999). The relationships between soil clay content and evaporation rate under different wheat straw mulch thicknesses were insignificant (Shangning and Unger, 2001). However, Gill and Jalota (1996) found that evaporation reduction was higher for a silty clay loam soil than for a sandy loam, under application of 2, 4 and 8 t ha^{-1} straw mulch. Cumulative evaporation reduction at 46 days were 5, 20 and 54 mm in silty clay loam and 6, 7 and 24 mm in sandy loam soil, with application of 2, 4 and 8 t ha^{-1} straw mulch, respectively.

Effect of mulching on soil moisture content

Mulching the soil may affect soil moisture content. Mulch benefits crop yield by improving soil physical conditions, including improved structural stability in the topsoil (De Silva and Cook, 2003). Many types of mulchs lead to an increase in soil moisture content as a result of decreased evaporation from the soil surface compared to that of bare soil (Maged, 2006; Wu *et al.*, 2017). Mineral mulch acts as impervious layer to prevent water vapor and is thus expected to conserve soil water more efficiently than organic mulch (Lei *et al.*, 2004). However, the combination of mulching with minimum tillage increased the conservation of soil moisture (Grevers *et al.*, 1986; Bhagat and Acharya, 1987). Through the soil profile, it was found that the moisture content was always higher between 0-60 cm soil layer under the mulch compared to bare soil (Ramakrishna *et al.*, 2006). Diaz *et al.* (2005) reported the greatest reduction in soil moisture content under mulch applied at 10 cm (92%), followed at 5 cm (83%), and at 2 cm (52%).

The application of black polyethylene mulch resulted in higher soil water contents compared to bare soil. Cook *et al.* (2006) found that the amount of moisture stored in the soil profile to a depth of 90 cm was significantly greater under polyethylene mulch compared to bare soil, or to a depth of 200 cm by used black plastic (Liu *et al.*, 2016). Also, drip irrigation under plastic mulch was able to control the water amount to a depth of 60 cm and reduce the water requirement to 20% (Zheng *et al.*, 2017). By using polythene, the water content was higher under mulch compared to bare soil of various textures (Chen, 1985). Also, the water vapor flux density with polyethylene mulch in the top 20 cm of the soil was 1.7 times that of the bare soil (Ramakrishna *et al.*, 2006), while the plastic film mulch treatment improved soil water content in the 0-160 cm depth (Gao *et al.*, 2014). Liles and Dosmann (1999) reported that the conservation of soil moisture by mulching with gravel and crushed rocks was significant. Also, among the various functions of gravel mulch, increase of resistance to water (vapour) transport is the most important (Yamanaka *et al.*, 2004). Li (2003) found that the soil moisture content under gravel mulch was significantly higher compared to the bare soil, especially between 20-60 cm depth. Also, the gravel-sand mulch increased the soil moisture storage by 72.6 mm compared to the bare soil between May and October; this indicates that gravel mulch has a high potential for soil water conservation.

Concrete mulching enabled the efficient conservation of soil water by stopping the evaporation of soil moisture (Lei *et al.*, 2004). The soil moisture under a concrete mulch was higher than that under plastic film mulch and that of bare soil(Yang *et al.*, 2006).

Under potential evaporation rates between 3-12 mm day^{-1}soil, water content increased with increased straw mulch rates. However, although straw mulching benefits soil water conservation for the initial period of evaporation(Shangning and Unger, 2001; Chen *et al.*, 2017), it may not be beneficial for the final stage of evaporation. It has been reported that straw mulching improved rainfall storage during the entire season (Cai *et al.*, 2015).

Change in soil heat under mulching

The various types of mulching affect soil temperature in different ways. Heat storage in the mulch layer is small, but the available energy at a mulch site is affected by the heat storage in the mulch layer (Price *et al.*, 1998).

There are different heat storage values for different types of mulches; for example, there is more storage of heat in black biodegradable polymer than in paper, polyethylene, Hessian, sugar cane trash and sawdust mulches (Olsen and Gounder, 2001).

Generally, by modifying the radiation budget of the soil surface, the mulches directly affect the soil microclimate (Liakatas *et al.*, 1986); for example, the plastic film mulch is probably the best mulch for increasing soil temperature. However, a plastic mulch affects the soil temperature in many ways, it reduces heat loss, emission of long wave radiation and evaporation, thus increasing soil temperature (Rickard, 1976). Ramakrishna *et al.* (2006) and Wn et al. (2017) confirmed that the soil temperatures under plastic film mulches are higher compared to those without mulching. For example, polythene mulch increased the soil temperature by about 4-6 °C at depth between 5-10 cm, and the mean soil temperature at 20cm depth was 2-3 ˚C higher under plastic mulch compared to bare soil (Fan *et al.*,2017). Hummel *et al.* (2002) reported that the type of ground cover significantly affected temperature in the upper 12-cm and the highest soil temperatures were observed under plastic mulch compared to bare soil.

The color of the plastic mulch gave different results on soil temperature(Lippert and Witing, 1964). The average soil temperature was highest under clear plastic mulch compared to black plastic mulch and bare soil (Maged, 2006). For example, a clear plastic mulch may permit warming of 3 to 8 °C to a depth of 5 cm, whereas black plastic permits warming of 2 to 3.5 °C, over that depth. This is because black plastic mulch is an opaque black body absorber and radiator; clear plastic increased soil temperature more than black and silver plastic mulch (Maged, 2006). Yang *et al.* (2006) reported that a clear plastic film mulch in the winter was more effective in increasing soil temperature than other mulches, such as concrete and straw.

The heat storage capacity and thermal diffusivity for gravel mulch is higher compared to that for bare soil and affected soil temperature. Moreover, the thermal conductivity of a gravel-sand mulch is lower than that of bare soil, and the mulch acts as an insulator during the hottest part of the day and retains soil heat at night (Li, 2003).

The soil temperatures between 3-10 cm depth were higher for a gravel mulch treatment compared to the topsoil without mulch (Nachtergaele *et al.*, 1998), and the soil temperature at 10 cm depth was 0.5-4.5 °C higher for the top soil with a gravel-sand mulch compared to the top soil without mulch. Li (2003) found that the temperature of soil with sand mulch is lower than that of bare soil. Mehuys *et al.* (1975) found that when a gravel mulch was placed on the surface of dry soil, soil temperatures directly beneath the gravel-sand mulch during daytime were lower than away from the gravel-sand mulch. However, at night, temperatures under the gravel-sand mulch were higher than those at a similar depth in the bare soil.

The thermal properties of concrete mulch is close to stone, gravel and rock. During winter, the plastic film mulch was more effective than concrete mulch in increasing soil temperature (Yang *et al.*, 2006). Lei *et al.* (2004) reported that concrete mulch increased the soil surface temperature in the 10-cm layer by about 2 °C during the night time, in the summer and in the winter.

Organic mulches such as straw and compost have an effect on soil temperature (Sekhon *et al.*, 2005). For example, the temperature beneath wheat straw was lower than under compost and bare soil (Cook *et al.*, 2006; Chen *et al.*, 2017). Sekhon *et al.* (2005) found that the maximum soil temperature ranged from 37.3 to 42.8 °C under bare soil and from 32.9 to 39.3 °C under wheat straw mulch, i.e. reduced temperature by 2.8-6.9 °C. Also, according to Cook *et al.* (2006) the soil temperature was reduced by 2 °C for wheat straw applied at 4-6 t ha^{-1} rate, compared to that of bare soil. Especially in the morning and during the afternoon, soil temperatures under the wheat straw applied at 4-6 t ha^{-1} were 2.8 °C lower than those of the bare soil. According to Sarkar and Singh (2007), soil mulching by straw at 5 t ha^{-1} rate increased the soil temperature compared to bare soil during the early hours of the morning, but decreased it during midday. Price *et al.* (1998) found that the average noontime temperature was 9.2 °C higher over bare peat in the summer compared to mulched peat. However, in the winter the wheat straw mulch at 15 t ha^{-1} rate decreased the temperature of mulched soil compared to bare soil, and on sunny days the soil temperature under the straw mulch from 7 am – 2 pm was similar to that measured for bare soil. However, after 2 pm the soil temperature under straw mulch began to decrease more than for the bare soil. On cloudy days, the soil temperature under straw mulch was similar to that in bare soil from 7 am to 2 pm, and after 2 pm the soil temperature under straw mulch was lower than that in bare soil (Yang *et al.*, 2006). Hence, the difference between cloudy and sunny days only became evident after 2 pm.

Effect of mulching on soil water flow

Hillel (2004) reported that the mulching reducing the force driving water upward through the soil profile; and decreasing the hydraulic conductivity or diffusivity of the soil layer. During the first stage of evaporation the mulch on the soil surface decreases capillary diffusion (Li, 2003). the straw mulch disrupted the upward capillary flow by cut off the liquid water supply to the soil surface (Gill and Jalota, 1996). Several studies have confirmed that straw mulching increased soil porosity (Gajriet al.1994) enhanced water infiltration (Głąb and Kulig, 2008, Adekalu *et al*. 2007) and reduced runoff and soil erosion (Bhatt and Khera, 2006). Straw mulching significantly reduced soil loss by over 49%, and enhanced water infiltration by over 31%

compared to the unmulched treatment (Zhang *et al*. 2016). The laboratory experiments showed that mulch with application of 2 and 4 t ha^{-1} straw mulch caused reductions of the runoff peak by 21% and 51% respectively, while the mulching increased infiltration and drainage through the soil, and at all rainfall rate the mulching reduced erosion rates.(Montenegro et al. 2012). Some researchers have reported that rock mulching significant increases in the infiltration rate, with the consequent reduction in erosion (Collinet and Valentin 1984; Tejedor *et al.* 2003). Shi *et al.* (2013) published that the mulch rates reduced the runoff coefficient values and soil loss when compared with the bare soil case.

CONCLUSIONS

The influence of mulching on the physical properties of agricultural soil can be summarized as follows:

- Studies have reported contradictory results about the effect of mulching on greenhouse gas emissions.
- The effect of mulching on evaporation depends on the type of mulch. Mulching generally affects a field's energy balance by changing the surface radiation budget, by modifying the albedo of the soil surface or shading the soil surface. This has an effect on net radiation.
- The mulch also breaks up capillary diffusion, and water moves from the soil surface to the mulch surface mostly in the vapor phase, especially during the first stage of evaporation.
- Through its effect on energy and water balance, mulching of the soil also affects soil water content and soil temperature, the extent to which depends on the type and thickness of the mulch, the soil texture type and climatic conditions.

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الملخص العربي

تأثير التغطية على الخصائص الفيزيائية للبيئة الزراعية

عبد العزيز بانى الحربى

يعد الاستخدام الواسع لنظام التغطية من قبل المنظومة الزراعية في معظم أنحاء العالم وبتطبيقات متعددة ضروريًا لتحسين معرفتنا بآثار التغطية على الخصائص الفيزيائية للتربة. وبالتالي تشرح هذه المقالة آلية هذا التطبيق. بشكل عام، تؤثر التغطية على توازن طاقة الحقل عن طريق تغيير ميزان الإشعاع السطحي، وذلك عن طريق تعديل معامل الانعكاس لسطح التربة أو تظليله. كما أن هذا له تأثير على صافي الإشعاع الشمسي. وتؤثر التغطية على التبخرعن طريق كسر الانتشار الشعرى للتربة والذي يعتمد على نوع التغطية. كما تؤثر التغطية أيضًا على المحتوى المائي ودرجة حرارة التربة، والذي يعتمد على نوع وسمك التغطية بالإضافة الى نوع قوام التربة والظروف المناخية. ومن جهة أخرى أفادت العديد من الدراسات أن تأثير التغطية على انبعاثات غازات الاحتباس الحراري غير واضح.