Available online at:
http://journal.unila.ac.id/index.php/tropicalsoil
DOI: 10.5400/jts.2022.v27i3.99

Effect of Pottery Irrigation and Mulching on Melon (*Cucumis melo*) Growth and Soil Properties of Alfisol and Entisol

Rahayu*, Komariah and Mei Pujiyarti

Departement of Soil Science, Faculty of Agriculture, Sebelas Maret University , Ir. Sutami Street No.36A, Jebres, Surakarta 57126, Indonesia. e-mail: rahayu_uns@yahoo.co.id

Received 03 December 2020 Revised 12 April 2022; Accepted 13 July 2022

ABSTRACT

The water supply in dry land depends on the rainfall, which causes agricultural constraints and limited water supply. The pottery irrigation method is considered capable of overcoming water shortages during the dry season. Pottery irrigation uses porous clay, so the water slowly comes out of the pottery and wet the surrounding soil. The research aimed to study the influence of pottery subsurface irrigation with and without mulching on watermelon growth and soil properties of clayey soil Alfisol and sandy soil entisol. The research was conducted on July 2019 in the experimental field Faculty of Agriculture, Karanganyar Regency. The experimental research design used a nested design with a 3-factor treatment that were soil type (T), fertilization method (P), and use of mulch (M). The types of soil were Alfisol (T1) and Entisol (T2). The fertilization methods were fertigation 100% (P1), fertigation 50% (P2), and banding fertilization 100% (P3). Mulch application included control, without mulch (M0) and mulch (M1). The combination of P1M1 treatment on alfisol and entisol soil showed the highest soil moisture with values of 23.1% and 22.5%, respectively. The highest fruit weight of melon in alfisol and entisol soils were indicated by the same treatment (P1M1) with values of 580.33 g and 616.5 g, respectively.

Keywords: Fertigation, melon, subsurface irrigation

INTRODUCTION

Consumption of melon (*Cucumis melo*) is increasing along with the increase in the better life of the community. However, the growth and yield of melons are affected by the availability of water and nutrients. Therefore, it is necessary to carry out balanced irrigation and fertilization. Irrigation volume affects the growth of melon plants. Manh and Wang (2014) reported that increased water availability could increase plant height, leaf area, and biomass weight of melon plants. Minimum irrigation (50% evapotranspiration) increases root growth but decreases the canopy growth of melons (Sharma *et al.* 2014). Sulistiyono and Riyanti (2015) also stated that, in general, irrigation volume treatment affects plant height, number of leaves, and melon fruit production. The irrigation volume for melon hydroponics with sand media during the vegetative growth phase was 1.0 times evaporation or equivalent to 170 cm^3 per day per plant, while during the generative phase, it was 1.5 times evaporation or equivalent to 234 cm^3 per day per plant in this study.

Technological developments in agriculture today must be maximally utilized. The use of water for crop irrigation must be considered in its efficiency. Irrigation that is not suitable can cause significant expenses, water resources, energy, and time and damage land resources. Haryati (2014) states that non-technical irrigation systems tend to increase waste in water use, reduce soil nutrient efficiency, and cause land damage due to inundation, especially if the irrigation system is not combined with drainage. Several irrigation systems have been developed in order to improve efficient irrigation. One way to provide water efficiently is with a drip irrigation system where water is given to plants directly on the soil surface and continuously with a slight discharge (Prastowo 2010). Another water-saving irrigation system is subsurface irrigation with pitcher irrigation, developed to increase the efficiency of using irrigation water for horticultural crops and fruits in Indonesia.

Technology Subsurface irrigation with the Pottery method is considered capable of overcoming water shortages and can increase the productivity of melons (*Cucumis melo*) in the dry season. With this irrigation system, it is hoped that the plants will provide good melon production in the dry season even though the water supply is small. Daka and Ellias (2002) stated that when the pottery part is put into the ground as far as the neck of the pottery, the part covered by the soil will be under atmospheric pressure. Atmospheric pressure, soil tension, and root suction power will force water to come out of the pottery, forming a water-wetting pattern around the pottery. This wetting process will continue until the soil moisture status is in equilibrium. This mechanism will be profitable to irrigate crops by planting them next to irrigated pottery.

Pottery irrigation in agriculture can be used as fertigation, namely the provision of fertilizers and irrigation. Hermantoro (2011) stated that the Pottery walls used as a fertigation system were able to release NPK fertilizer solution. The diffusion rate of the solution through the Pottery walls decreases as the difference in solution concentration decreases. The use of mulch as climate modification is also thought to help this irrigation system to retain soil moisture. Setyowati *et al.* (2018) found that the melon fruit weight per plant increases in the provision of silver and black plastic mulch. The provision of mulch can maintain soil moisture. The water needed will be available during photosynthesis, thus producing large and heavy fruit. In previous research, there has not been any fertilization method that is most appropriate to use in this irrigation system, and how is the effect of mulching as a climate modification in the Pottery irrigation system. This study aimed to determine the influence of pottery subsurface irrigation with and without mulching on watermelon growth and soil properties of clayey soil Alfisol and sandy soil Entisol.

MATERIALS AND METHODS

The research was conducted at the experimental field, Sukosari Village, Karanganyar Regency, from July until December 2019. Soil analysis was conducted at the Soil Science Laboratory. The materials used were pottery, solid fertilizer NPK Mutiara 16:16:16, manure/cow dung, and seeds of the melon plant (*Cucumis melo*). The pottery originated from the ceramics home industry center Bayat of Klaten region (Indonesia), a diameter of 20 cm and height of 25 cm with a volume of 7 liters, clay content of 90% and very fine sand of 10%, and a Cole value of < 0.03. The pottery irrigation head was a water-filling hole covered after filling with water. The pottery was buried in the soil of a 60 cm diameter growing media pot, and the head was exposed to fill the irrigation water. Water moved through the pottery wall through osmosis into the soil due to root and soil matrix adsorption. The pottery was filled with water whenever it became empty during the irrigation season. The amount of water was measured daily by measuring the height level of water in the pottery using a ruler.

The experimental research design used a nested design with three treatment factors, namely soil type (T), mulch (M), and fertilization fertigation (P). Soil types were alfisol soil (T1) and entisol soil (T2). While the use of mulch included control treatment/without mulch (M0) and with mulch (M1). The Alfisols had a clay texture, with 81.1% clay, 3.7% silt, and 15.3% sand. The soil chemical characteristics of alfisols were pH 6.18, organic C content 0.89%, CEC 26.05 me%, base saturation 36.58%, total N 0.07%, available P 7.07 ppm, and available K 5.02 ppm. The Entisol soils had the following characteristics of pH 6.7, organic C 0.95%, total N 0.18%, available P 8.18 ppm, and available K 11.13 ppm. Fertilization was through fertigation as much as 100% fertigation liquid fertilizer (P1), 50% fertigation liquid fertilizer (P2), and 100% immersed into soil fertilizer (P3). Pottery fertigation was diluting 1 kg NPK fertilizer with 100-liter water as 100 % fertigation, and 0,5 kg of NPK diluted with 100-liter water as 50%. Fertilization of immersed was NPK Mutiara 16:16:16 fertilizer as 5 g every application per plant in 14 days after planting (DAP), 24 DAP, 34 DAP, and 44 DAP.

Soil tillage was carried out one week before melon planting. The 4 ×1-meter soil beds were made of as many as six beds for each alfisol and entisol soil. The soil bed was then made into a hole with a depth of 40 cm and an area of 10 x 10 cm in each plot to plant pottery. Each pottery was planted with melon plants, with as many as four pieces surrounding the pottery. The distance between plants was 5 cm, so they could absorb water and fertilizer properly. Before planting, mulch was installed on the prepared plots. The mulch that had been installed was then perforated on the pottery, and four small holes around the pottery for planting plants. Before sowing, the melon seeds were soaked in water for about 4 hours. After 4 hours, the seeds were transferred to the nursery box for ten days. Seedlings that were ten days old were planted in the experimental beds. Plants were watered manually for five days after planting, and then fertigation irrigation was applied to pottery. In the early planting period until 14 DAP, the pottery was filled with water every three days. Subsequent irrigation is carried out every two days. Weeding was done once a week or if many weeds were around the plant. The initial fertilization was carried out during land cultivation using organic fertilizers as basic fertilizers.

The parameters observed were soil moisture content using stick moisture content using Lutron Professional Soil Moisture Meter (PMS-714), soil pH using soil ph moisture VT-05 in the field, and Organic C, total N, available P, available K. Meanwhile, the observation of plant variables included plant height, fruit weight, wet stover weight, and dry stover weight. Melon plants were harvested 65-70 days after planting. The characteristics of melons that were ready to harvest were fragrant, yellowish, and cracked fruit stalks. ANOVA test with a confidence level of 95% was carried out to determine the effect of treatment on the observed variables, then if the treatment had a significant effect, continue the Duncan Multiple Range Test (DMRT) for further test to compare between the treatment combinations.

RESULTS AND DISCUSSION

Table 1 shows the effect of the fertilization treatment on soil properties. Fertilization treatment significantly affects the soil moisture content, the soil available P, and the soil available K of entisol soil. However, other treatments did not show a significant value. The fertilization treatment at the dose of 100% fertilization gave the highest soil moisture content compared to other fertilization treatments for each soil. The submerged fertilization treatment at a dose of 100% showed the lowest soil moisture in both soils. Water seepage inside the pottery was influenced by the climate, the permeability of the pottery walls, and the soil condition. Woldu (2015) stated that the water flow from the pottery to the surrounding soil matrix is determined by the permeability of the earthenware walls and soil suction power. When the pottery walls are saturated, soil matrix suction power will be a major factor in controlling water flow inside the pottery. Thus the irrigation system with pottery is determined by many factors, including soil type, soil structure, soil fertility, plant species, weeds, evapotranspiration rate, and microclimate.

Banding fertilization treatment had the lowest available P value among the other two fertilization treatments for each soil type. Fertilization applied by fertigation causes fertilizers dissolved in irrigation water to be readily available for plant absorption. Stewart *et al*. (2005) stated that fertilization allows plants to absorb nutrients quickly and directly from the soil solution. In addition, the positive effect of fertilization is due to optimal moisture in the soil at the right time, and fertilization facilitates the use of P applied to plants.

The fertigation system causes a high fertilizer solubility and the use of the proper fertilizer dosage into the soil. The application of fertigation fertilizers at a dose of 100% gave higher available K values among the other two treatments for each soil. These results align with Silahooy (2008) that the increased dose of K can significantly increase the K uptake; this is related to the availability of K in the soil with the increasing dose given. Kaya (2014) stated that giving NPK fertilizer can increase soil K-available because of the nature of NPK fertilizer which is easily soluble in water. As much as 15% of K_2O in the fertilizer is dissolved in the soil, producing K cations in the soil solution.

The mulching treatment (Table 2) had nominal values on the yield of the water volume lost, organic carbon, and K available. However, it had a significant value on soil moisture, total N and P available in the soil. Mulch application could increase soil moisture, namely 50.33% on alfisol soil and 42.28% on entisol soil compared to the treatment without mulch. These

Table 1. Influence of fertilizer treatment on soil characteristics.

Treatments		SM (%)	V (Liter)	C-Org (%)	N (%)	P (ppm)	K (ppm)
T1	P1	19.2^{a}	157.29^{c}	2.11^{a}	0.046^{a}	33.86^{b}	55.18^{a}
	P2	19.2^{a}	165.14^{bc}	2.08^{a}	0.045^{a}	22.52^{bc}	46.86^{b}
	P3	18.4^{a}	167.86^{abc}	2.04^{a}	0.037^{a}	11.65^{c}	27.04^{c}
T2	P1	18.9^{a}	186.75^{abc}	1.63^{a}	0.043^{a}	60.66^{a}	31.40^{c}
	P2	18.5^{a}	208.32^{a}	1.31^{a}	0.055^{a}	61.87^{a}	27.83^{c}
	P3	16.6^{b}	200.93^{ab}	1.58^{a}	0.067^{a}	14.30^{c}	15.22^{d}

*) The number followed by the same letter shows no significance in the DMRT test level 5%. T1: Alfisol Soil; T2: Entisol Soil; P1: Fertigation 100%; P2: Fertigation 50%; P3: Banding Fertilizer 100%; SM: Soil Moisture; V: Water Volume.

Table 2. Influence of mulch application on soil characteristics.

Treatments		SM (%)	V (Liter)	C-Org (%)	N (%)	P (ppm)	K (ppm)
T1	M0	15.1[c]	151.94[b]	2.11[a]	0.029[c]	19.12[c]	42.23[a]
	M1	22.7[a]	174.92[ab]	2.09[a]	0.057[ab]	26.23[b]	43.82[a]
T2	M0	14.9[c]	195.26[a]	1.48[a]	0.041[bc]	42.25[a]	24.04[b]
	M1	21.2[b]	202.07[a]	1.54[a]	0.069[a]	48.97[a]	28.54[b]

*) The number followed by the same letter shows no significance in the DMRT test level 5%
T1: Alfisol Soil; T2: Entisol Soil; M0: No Mulch; M1: With Mulch; SM: Soil Moisture; V: Water Volume

results align with Telkar *et al*. (2017) that the use of mulch can increase soil moisture by reducing weed growth, protecting air reserves in the soil, and preventing runoff.

The treatment on alfisol soil was significantly different between mulch and without mulch. Available P in with mulch (M1) treatment had a value of 37.19% higher than without mulch (M0). While the entisol soil showed that were not significantly different without mulch and with mulch, where the available P values were 42.25 ppm and 48.97 ppm, respectively (Table 2). Treatment with mulch showed more available P than without mulch for each soil. Bahtiar *et al.* (2017) showed that the black silver plastic mulch and straw treatment had a higher available P value than without mulch, chemically related to soil pH. Sijm *et al*. (2000) stated that soil moisture affects changes in pH, for example, through soil water content which can change the concentration of minerals or substances in water and cause changes in pH when the soil becomes wet or dries up. Mulch treatment affects the pH value of the soil based on the moisture resulting from mulch, where the pH directly affects the availability of P. Hakim *et al*. (1986) stated that P availability is generally low in acidic and alkaline soils.

Wang and Xing (2016) explained that plastic film mulching had a good effect on preventing the leaching of soil Nitrate-N from the top layer to the underground layer. The results of this research, the amount of leaching in the mulch treatment was 28.61% and 39.14% lower than without mulch. The amount of soil leaching influences the soil N-total value, and in this study, it is closely related to the use of mulch as a treatment.

Based on the analysis results in table 3, the interaction of 100% fertigation fertilizer treatment and mulch (P1M1) gave the highest soil moisture value on alfisol soil. Nevertheless, it was not significantly different from 50% fertigation with mulch (P2M1) and 100% immersed fertilizer with mulch (P3M1). The highest soil moisture in entisol soil was found in P1M1 and was not significantly different from P2M1. From these results, it can be concluded that the interaction of fertilization and mulching treatment significantly affects the value of soil moisture. According to Tibebu *et al.* (2011) tomatoes grown under clay pot irrigation with the application of nitrogen fertilizer and irrigation water provide a significantly higher efficiency of fertilizer use than plot irrigation or clay pot irrigation with nitrogen fertilizers applied around it.

The combination of fertilization and mulching treatments did not significantly affect the volume of water lost from the pottery of this research. This pottery contained clay content of 90%, very fine sand of 10%, and a Cole value of < 0.03. After this, a study about the permeability of clay pot walls may be needed. Several other factors, such as soil suction power and the need for plant water, are also factors in the seepage from the pottery walls. Woldu (2015) stated that when a clay pot is filled with water and covered with a lid, and then buried in the soil, the water will gradually seep or exit the porous wall through diffusion and capillary force. Stein (1990) explained that this occurs because of the difference in hydraulic or hydrostatic pressure (difference in water content) between the surface of the pot and the surrounding soil and then continues until the saturation level reaches equilibrium with the surrounding area. The water infiltration rate depends on the plant and soil type and the surrounding climate. A pore size distribution of clayey soil is more uniform than sandy soil, and more of the water is adsorbed, increasing the matric suction.

Organic C values of all treatments on the two soils were not significantly different, indicated by the same letter notation (Table 3). However, the treatment on alfisol soil showed a relatively high average organic C values compared to entisol soil. The highest organic C value of the two soils was found in entisol soil with a 50% dose of fertilization with mulch, and alfisol soil (P2M1) which was 2.69%, shows the lowest organic C content.

Table 3. Influence of fertilizers combination and mulch application on soil characteristics.

Treatments		SM (%)	V (Liter)	C-Org (%)	N (%)	P (ppm)	K (ppm)
T1	P1M0	15.2^{de}	155.17^{bc}	1.76^{a}	0.03^{cde}	24.44^{c}	57.55^{a}
	P1M1	23.1^{a}	159.40^{bc}	2.46^{a}	0.061^{abcd}	43.28^{b}	52.80^{ab}
	P2M0	15.7^{d}	146.73^{c}	2.69^{a}	0.040^{bcde}	18.72^{c}	45.67^{b}
	P2M1	22.8^{ab}	183.56^{abc}	1.47^{a}	0.051^{abcde}	26.33^{c}	48.05^{ab}
	P3M0	14.5^{ef}	153.92^{bc}	1.73^{a}	0.017^{e}	14.21^{c}	23.47^{d}
	P3M1	22.3^{ab}	181.80^{abc}	2.35^{a}	0.058^{abcd}	13.58^{c}	30.60^{cd}
T2	P1M0	15.4^{d}	191.84^{abc}	1.85^{a}	0.037^{bcde}	60.16^{a}	28.23^{cd}
	P1M1	22.5^{ab}	181.67^{abc}	1.42^{a}	0.049^{abcde}	61.16^{a}	34.57^{c}
	P2M0	15.1^{de}	222.92^{a}	0.89^{a}	0.024^{de}	68.34^{a}	27.43^{cd}
	P2M1	21.9^{b}	193.72^{abc}	1.73^{a}	0.086^{a}	55.41^{ab}	28.23^{cd}
	P3M0	14.2^{f}	171.02^{abc}	1.69^{a}	0.064^{abc}	18.42^{c}	12.37^{e}
	P3M1	19.1^{c}	215.95^{ab}	1.46^{a}	0.071^{ab}	10.18^{c}	11.58^{e}

*) The number followed by the same letter shows no significance in the DMRT test level 5%. T1: Alfisol Soil; T2: Entisol Soil; P1: Fertigation 100%; P2: Fertigation 50%; P3: Banding Fertilizer 100%; M0: No Mulch; M1: With Mulch; SM: Soil Moisture; V: Water Volume.

Furthermore, there is even a decrease in the organic C content in the initial soil by 6.6%. The decrease in soil organic C can be caused by fertilization treatment. Adviany *et al.* (2019) stated that the intensive use of N fertilizers will stimulate the mineralization of soil organic matter. They are causing a decrease in organic C levels in the soil. The decomposition process of organic matter can also cause a decrease in organic C in the soil, broken down into inorganic compounds so that the organic C content decreases (Sukarwati, 2011).

The results of the Duncan test analysis (Table 3) show that the highest total N value in entisol soil is found in the combination of 50% fertilization and mulch (P2M1), as much as 0.0857%. This value differed significantly from the same treatment but without mulch (P2M0) which is 0.0235%. Judging from each treatment, the effect of mulching was evident in the presence of total soil N. The presence of total N is positively correlated with soil moisture with 0.392. The positive correlation indicates that an increase in soil moisture will also increase in total soil N. The results in this study are consistent with those of Agehara and Warncke (2005) namely that urease activity increases due to increased soil moisture from dry air to field capacity in two semi-arid soils (alfisol and vertisol). Agehara and Warncke (2005) also stated that in the control treatment increased soil moisture significantly increased mineralization.

The available K of alfisol soil had the highest value in the P1M0 treatment that was 57.55% and did not significantly different from P1M1 and P2M1. In entisol soil, the highest available K value was in the P1M1 treatment, significantly different from the P3M0 and P3M1 treatments. Using fertilizers at a dose of 100% gave available K values higher than the other two treatments on each soil. The results can be caused by the high fertilizer solubility with the fertigation system and the use of the correct fertilizer dose in the soil. These results align with Silahooy (2008) that increasing dose of K can significantly increase the K uptake, which is related to the availability of K in the soil with the increasing dose given. Kaya (2014) stated that giving NPK fertilizer can increase soil available K because of the nature of NPK fertilizer which is easily soluble in water. The 15% K_2O contained in this fertilizer is dissolved in the soil and produces K cations in the soil solution.

Soil moisture shows different results every day for three months (Figure 1). The soil moisture value at the beginning of the measurement looks stable, then fluctuates at the end of August and September. The results occur due to climate change with increasing air temperature, so evaporation on the soil is also high. In addition, the large volume of water seeping from the pottery is also a driving factor for the high and low humidity of the soil. Soil moisture began to stabilize again in October, and at the end of the measurement of soil moisture values with mulch, the treatment showed almost the same results every day. The average soil moisture also shows a higher number from August to October, except for the P2M1, P3M0, and P3M1 treatments on entisol soils and P3M1 on alfisols (Table 4). Based on Figure 2

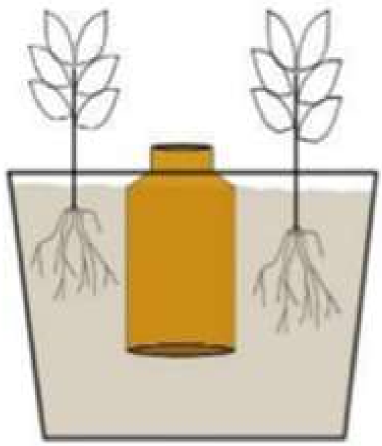

Figure 1. Pottery with diameter size 20 cm and high 25 cm.

and Figure 3, soil moisture both on alfisol soil (T1) and on entisol soil (T2) showed results where mulching (M1) showed higher yields than without mulch (M0). Treatments P1M1, P2M1, and P3M1 showed higher yields and were in the range of 25-30% compared to treatments P1M0, P2M0, and P3M0 which were only in the range of 15-25%.

Plants need much water for evapotranspiration, which is influenced by growth rates, climatic factors, and plant types in several growth phases. Soil moisture affects the growth phase of melon (*Cucumis melo*). Resh (2004) explained that the water needs of melon plants are divided into five growth stages. The initial stage (15 days) is marked by the start of the growth of the main stem and leaves. The growth of future branches marks the vegetative stage (25 days), and the flowering stage (20 days) is marked by the ovaries that enlarge and become real fruit. The ripening stage (10 days) is marked by a change in fruit color and a fragrant aroma.

Based on Table 5, the highest volume of water lost from pottery on alfisol soil is in August, namely 100% immersion fertilization treatment and with mulch (P3M1) of 64.95 L. The volume of water lost to alfisol soil in September increased on average compared to August, then decreased again in October. The volume of water lost in entisol soils also increased from August to September, then decreased in October. The different evapotranspiration in each month could be affected the water lost. Soil moisture conditions can also cause a decrease in water seepage from the pottery due to changing hydraulic conductivity. The results of the analysis of the volume of water lost (Figure 4 and 5) show that the volume of water lost in alfisol soil (T1) is much more volatile and higher than that of entisol soil (T2), which fluctuates much lower.

The results of this study indicate that the lowest fruit weight in the alpha soil was found in the fertilizer treatment with 100% immersed fertilizer without mulch (P3M0) of 425 grams, while the highest was at 100% fertigation fertilizer with mulch (P1M1) of

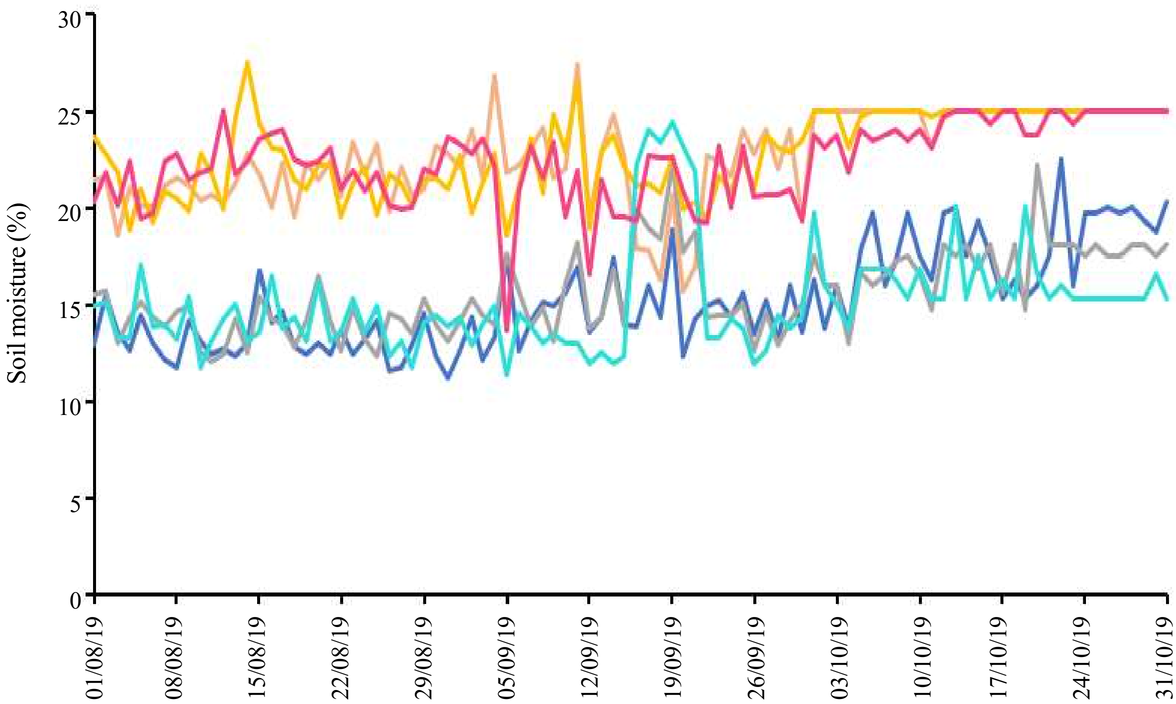

Figure 2. Daily soil moisture around the pottery of alfisol. : (T1)P1M0, : (T1)P1M1, : (T1)P2M0, : (T1)P2M1, : (T1)P3M0, : (T1)P3M1.

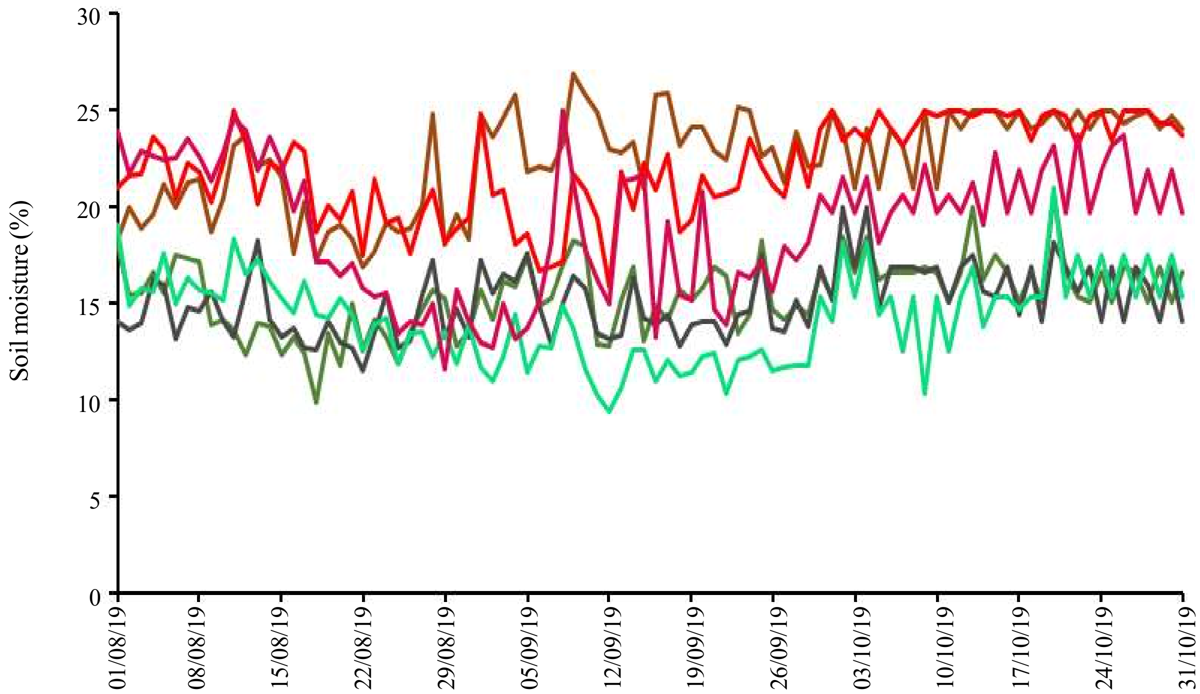

Figure 3. Daily entisol soil moisture around the pottery of entisol. : (T2)P1M0, : (T2)P1M1, : (T2)P2M0, : (T2)P2M1, : (T2)P3M0, : (T2)P3M1.

580.33 grams (Table 8). Using pottery as a means of fertigation to meet water and plant nutrition needs is considered capable and efficient. The use of mulch, on average, also increased melon fruit weight, although it was not significant. Sudjianto and Krestiana (2009) stated that black silver plastic mulch produces the highest fruit weight and sugar content. The silver color of this mulch can reflect light which can be helpful in the photosynthesis process so that more carbohydrates are formed.

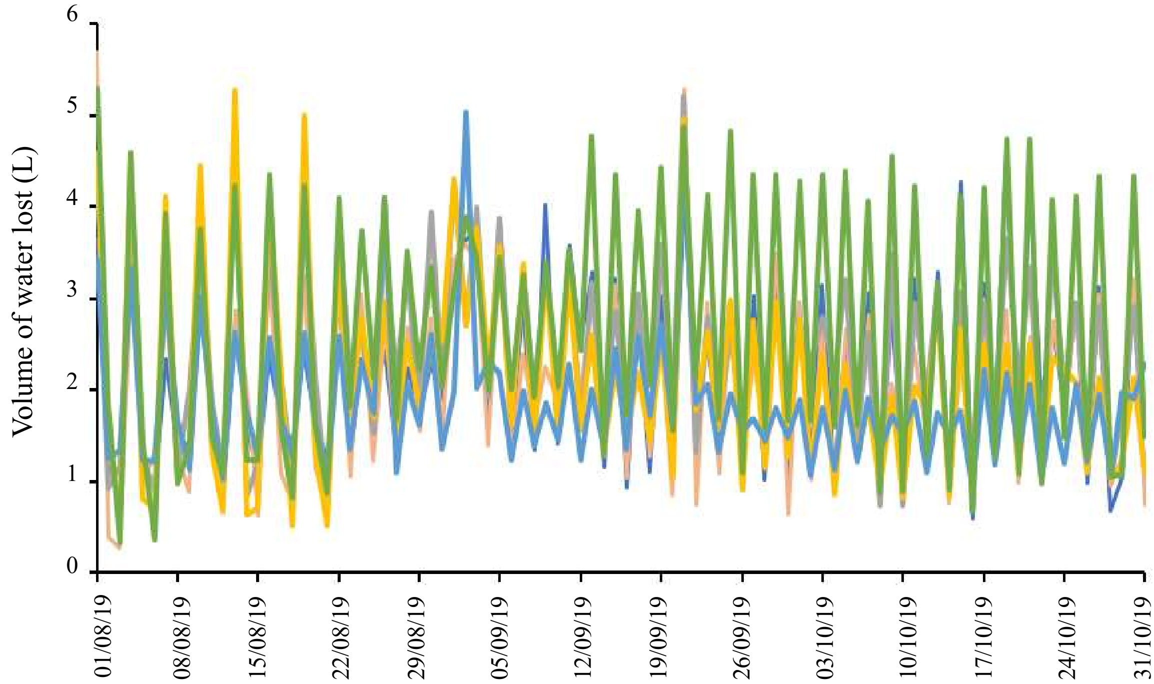

Figure 4. Daily water moves out from pottery on alfisol. : (T1)P1M0, : (T1)P1M1, : (T1)P2M0, : (T1)P2M1, : (T1)P3M0, : (T1)P3M1.

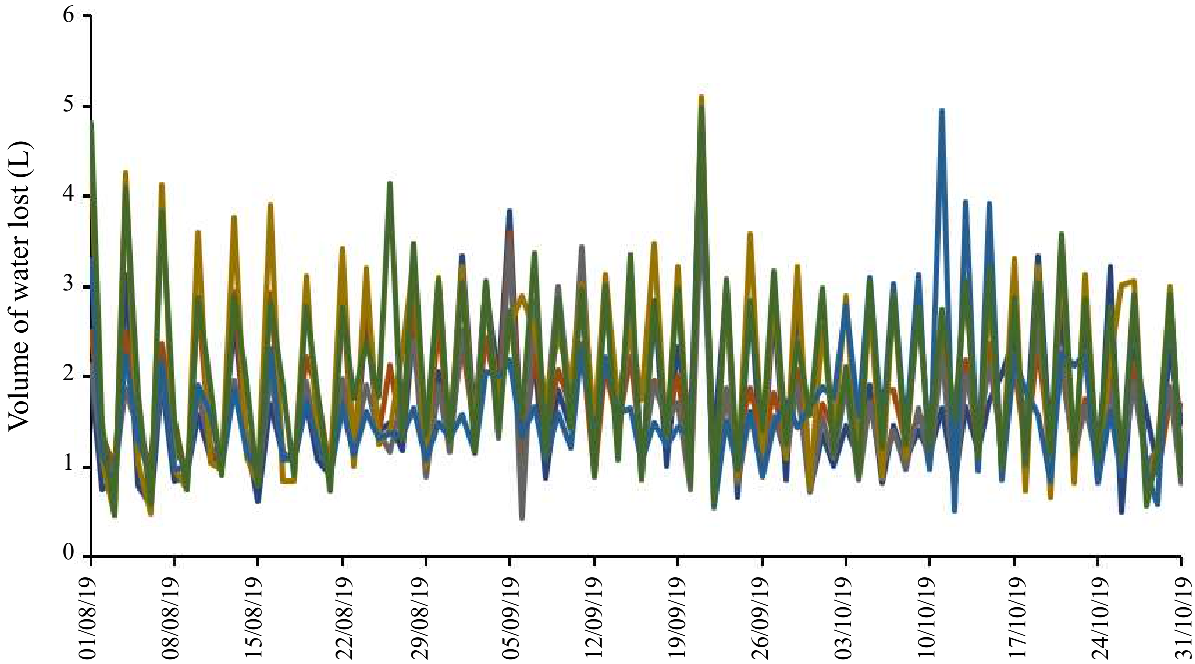

Figure 5. Daily water moves out from pottery on entisol. : (T2)P1M0, : (T2)P1M1, : (T2)P2M0, : (T2)P2M1, : (T2)P3M0, : (T2)P3M1.

Fertilization using fertigation at a dose of 100% (P1) provided the highest plant height compared to the other two treatments (Table 6). Even so, the three fertilization treatments showed no significant difference. The presence of soil N influences the increase in plant height; as stated by Lende (2009), plant height growth is more influenced by nitrogen dose factors and plant growth types. The nitrogen doses in the P1 and P3 treatments further stimulated the growth of melon plants *(Cucumis melo)* because they had a fertilizer dose of 100%.

The use of mulch also showed better plant height yields than without mulch on each soil (Table 7). Rahmah *et al*. (2014) stated that the water vapor loss rate through mulch is slower than from the direct soil surface so that water supply is maintained and metabolism runs smoothly can also avoid drought stress which can inhibit growth.

Giving plastic mulch to melon plants is thought to be able to wet and show high melon crop yields (Table 7). Kurniastuti *et al*. (2017) explained that giving black silver plastic mulch can increase melon yields up to 15.56% higher than without mulch and increase 6.07% higher than straw mulch. Multazam (2014) also stated that the treatment of plastic mulch and chicken manure resulted in the highest

Table 4. The monthly average of soil moisture around the pottery.

Treatments		Soil Moisture (%)		
		August	September	October
T1	P1M0	13.13^{d}	14.66^{ef}	17.87^{c}
	P1M1	21.31^{a}	21.84^{ab}	24.94^{a}
	P2M0	13.98^{cd}	15.65^{ef}	17.22^{cd}
	P2M1	21.67^{a}	21.91^{bc}	24.92^{a}
	P3M0	14.02^{cd}	15.26^{fg}	16.15^{d}
	P3M1	21.87^{a}	20.95^{c}	24.33^{a}
T2	P1M0	14.17^{cd}	15.42^{e}	16.53^{cd}
	P1M1	19.86^{b}	23.63^{a}	24.05^{a}
	P2M0	14.16^{cd}	14.79^{ef}	16.24^{cd}
	P2M1	20.89^{a}	20.55^{c}	24.45^{a}
	P3M0	14.95^{c}	12.02^{g}	15.59^{d}
	P3M1	19.22^{b}	17.07^{d}	20.87^{b}

Table 5. The volume of water lost monthly.

Treatments		The volume of water lost (L)			
		August	September	October	Total
T1	P1M0	44.40^{c}	61.02^{abc}	50.03^{b}	155.17^{bc}
	P1M1	54.52^{bc}	54.26^{bc}	50.62^{b}	159.40^{bc}
	P2M0	45.11^{c}	55.22^{bc}	46.40^{b}	146.73^{c}
	P2M1	61.21^{abc}	68.12^{abc}	62.34^{ab}	183.56^{abc}
	P3M0	44.70^{c}	48.19^{c}	61.02^{ab}	153.92^{bc}
	P3M1	64.95^{ab}	64.17^{abc}	61.24^{ab}	181.80^{abc}
T2	P1M0	58.69^{abc}	72.40^{abc}	69.13^{ab}	191.84^{abc}
	P1M1	59.76^{abc}	68.24^{abc}	60.91^{ab}	181.67^{abc}
	P2M0	73.13^{a}	77.97^{ab}	70.57^{ab}	222.92^{a}
	P2M1	69.47^{ab}	70.50^{abc}	54.01^{b}	193.72^{abc}
	P3M0	60.72^{abc}	60.52^{bc}	49.78^{b}	171.02^{abc}
	P3M1	75.34^{a}	89.26^{a}	82.94^{a}	215.95^{ab}

*) The number followed by the same letter shows no significance in the DMRT test level 5%. T1: Alfisol Soil; T2: Entisol Soil; P1: Fertigation 100%; P2: Fertigation 50%; P3: Banding Fertilizer 100%; M0: No Mulch; M1: With Mulch.

Table 6. Influence of fertilizer treatment on plant growth and yield.

Treatments		Fruit Weight (g)	Plant Height (cm)	Wet Weight (g)	Dry Weight (g)
T1	P1	425.25^{c}	117.88^{a}	319.75^{abc}	147.25^{a}
	P2	482.25^{bc}	103.88^{a}	282.38^{c}	119.12^{a}
	P3	458.50^{bc}	111.75^{a}	306.00^{bc}	124.13^{a}
T2	P1	606.38^{a}	123.00^{a}	333.88^{ab}	143.25^{a}
	P2	616.25^{a}	126.00^{a}	362.50^{a}	131.25^{a}
	P3	553.12^{ab}	121.12^{a}	330.62^{ab}	136.75^{a}

*) The number followed by the same letter shows no significance in the DMRT test level 5%. T1: Alfisol Soil; T2: Entisol Soil; P1: Fertigation 100%; P2: Fertigation 50%; P3: Banding Fertilizer 100%.

Table 7. Influence of mulch treatment on plant growth and yield.

Treatments		Fruit Weight (g)	Plant Height (cm)	Wet Weight (g)	Dry Weight (g)
T1	M0	436.33^{c}	106.58^{b}	294.75^{b}	109.25^{b}
	M1	498.88^{bc}	115.75^{ab}	310.67^{b}	151.08^{a}
T2	M0	578.42^{ab}	119.50^{ab}	331.25^{ab}	119.92^{b}
	M1	605.42^{a}	127.25^{a}	353.42^{a}	154.25^{a}

*) The number followed by the same letter shows no significance in the DMRT test level 5%. T1: Alfisol Soil; T2: Entisol Soil; M0: Without Muluch; M1: With Mulch.

vegetative growth, such as leaf area and the number of leaves, compared to the treatment without mulch and straw mulch.

Based on Table 8, 100% fertigation treatment with mulch on alfisol soil increased dry plant stover by 63.53%. Fertigation treatment at 100% dose of fertigation with mulch on alfisol soil (P1M1) was not significantly different from that of 50% fertilization with alfisol soil mulch (P2M1) but significantly different from other treatments. All treatments without mulch had insignificant values except for the 50% fertilization treatment on entisol soil (P2M0). The difference in plant dry stover weight is thought to be due to differences in the intensity of sunlight received by plants. As stated by Haryanti (1989) that the production of plant dry

Table 8. Influence of combination fertilizers and application mulch treatment on plant growth and yield.

Treatments		Fruit Weight (g)	Plant Height (cm)	Wet Weight (g)	Dry Weight (g)
T1	P1M0	420.50^{c}	105.50^{ab}	305.25^{abc}	111.75^{ef}
	P1M1	580.33^{abc}	130.25^{ab}	334.25^{abc}	182.75^{a}
	P2M0	458.75^{abc}	102.25^{b}	280.75^{c}	105.5^{ef}
	P2M1	505.75^{abc}	105.50^{ab}	284.00^{c}	132.75^{cd}
	P3M0	425.00^{bc}	112.00^{ab}	298.25^{bc}	110.5^{ef}
	P3M1	492.00^{abc}	111.50^{ab}	313.75^{abc}	137.75^{c}
T2	P1M0	596.25^{a}	107.25^{ab}	309.75^{abc}	111^{ef}
	P1M1	616.50^{a}	138.75^{ab}	358.00^{ab}	175.5^{ab}
	P2M0	589.67^{ab}	115.00^{ab}	374.00^{a}	134.25^{c}
	P2M1	616.75^{a}	137.00^{a}	351.00^{abc}	128.25^{cde}
	P3M0	523.25^{abc}	136.25^{ab}	310.00^{abc}	114.5^{def}
	P3M1	583.00^{abc}	106.00^{ab}	351.25^{abc}	159^{b}

*) The number followed by the same letter shows no significance in the DMRT test level 5%. T1: Alfisol Soil; T2: Entisol Soil; P1: Fertigation 100%; P2: Fertigation 50%; P3: Banding Fertilizer 100%; M0: Without Mulch; M1: With Mulch.

matter depends on sun reception and uptake of carbon dioxide and water in plants. Rahayu *et al.* (2012) added that differences in genetic factors between varieties also cause differences in dry stover weight.

CONCLUSIONS

Treatment with the low permeable volume of water on the alfisol and entisol soils respectively were fertigation 50% without mulching and banding fertilization 100% without mulching. Even so, the result of fruit weight values were not significant. Fertigation 100% with mulching produced the highest average soil moisture in both alfisol and entisol, and showed the highest total N and available P values in Alfisol. Meanwhile, fertigation 50% with mulching showed a good average in soil properties on Entisol soil. The highest plant growth and yields among treatments were obtained by fertigation 100% and use mulching.

ACKNOWLEDGMENTS

Universitas Sebelas Maret Surakarta supported the study under the research grant of DIKTI 2019-2020.

REFERENCES

Adviany I and DD Maulana. 2019. Pengaruh pupuk organik dan jarak tanam terhadap C-Organik. populasi jamur tanah dan bobot kering akar serta hasil padi sawah pada inceptisols Jatinangor. Sumedang. *Agrotech Research J* 3: 28-35. (in Indonesian).

Agehara S and DD Warncke. 2005. Soil moisture and temperature effects on nitrogen release from organic nitrogen sources. *Soil Sci Soc Am J* 69: 1844-1855.

Bahtiar FY, Sudadi and VR Cahyani. 2017. Sifat Kimia Tanah. Populasi Bakteri Pelarut Fosfat. dan Hasil Cabai pada Aplikasi Beberapa Jenis Mulsa pada Inceptisol Ngemplak. Boyolali. *J Sustainable Agriculture* 32: 75-83. (in Indonesian).

Hakim N, MY Nyakpa, SG Lubis, MR Nugroho, MA Saul, GB Diha, Hong and HH Bailey. 1986. *Dasar-dasar Ilmu Tanah*. Universitas Lampung. Lampung Tanah. (in Indonesian).

Haryanti S. 1989. Respon pertumbuhan jumlah dan luas daun nilam (Pogostemmon cablin Benth) pada tingkat naungan yang berbeda. *Buletin Anatomi Dan Fisiologi dh Sellula* 16: 20-26. doi: https://doi.org/10.14710/baf.v16i2.2590. (in Indonesian).

Haryati U. 2014. Teknologi Irigasi Suplemen untuk Adaptasi Perubahan Iklim pada Pertanaman Lahan Kering. *J Sumberdaya Lahan* 8: 43-57. (in Indonesian).

Hermantoro. 2011. Teknologi inovatif irigasi lahan kering dan lahan basah studi kasus untuk tanaman lada perdu. *J Agroteknose* V: 37-44. (in Indonesian).

Kaya E. 2014. Pengaruh pupuk organik dan pupuk NPK terhadap pH dan K-tersedia tanah serta serapan-K, pertumbuhan dan hasil padi sawah (*Oryza sativa* L.). *Buana Sains* 14: 113-122. (in Indonesian).

Kurniastuti T and DR Faustina. 2017. Pengaruh dosis pupuk kompos jerami dan jenis mulsa terhadap pertumbuhan dan produksi tanaman melon (Cucumis melo L.). *J Pertanian Terpadu* 7: 79-88. (in Indonesian).

Manh VH and CH Wang. 2014. Vermicompost as an important component in substrate: Effects on seedling quality and growth of muskmelon (*Cucumis melo L.*). *APCBEE Procedia* 8: 32-40.

Multazam MA, A Suryanto and N Herlina. 2014. Pengaruh pemberian macam pupuk organik dan mulsa pada tanaman brokoli (*Brassica olleraceae* L. Var. *Italica*). *J Produksi Tanaman* 2: 154-161. (in Indonesian).

Prastowo. 2010. Irigasi Tetes Teori dan Aplikasi. IPB Press. Bogor. 33 p. (in Indonesian).

Rahayu, Mulyati, S Susiarti and VBS Lestari. 2012. A preliminary ethnobotanical study on useful plants by local communities in Bodogol Lowland Forest, Sukabumi, West Java. *J Trop Biol Conserv* 9: 115-125.

Rahmah A, M Izzati and S Parman. 2014. Pengaruh pupuk organik cair berbahan dasar limbah sawi putih (*Brassica chinensis L.*) terhadap pertumbuhan tanaman jagung manis. *Bul Anatomi dan Fisiologi* XXII: 65-71. (in Indonesian).

Resh HM. 2004. *Hydroponic food production: a definitive guidebook for the advanced home gardener and the commercial hydroponic grower*. CRC Press, New Jersey. 635 p.

Setyowati M, T Sarwanidas and M Maimunsyah. 2018. Pengaruh jenis mulsa dan dosis pupuk NPK terhadap pertumbuhan dan hasil tanaman melon (*Cucumus melo* L.). *J Agrotek Lestari* 2: 37-46.

Sharma SP, DI Leskovar, KM Crosby, A Volder and AMH Ibrahim. 2014. Root growth, yield, and fruit quality responses of reticulatus and inodorus melons (Cucumis melo L.) to deficit subsurface drip irrigation. *Agric Water Manag* 136: 75-85. doi: 10.1016/j.agwat.2014.01.008.

Sijm D, R Kraaij and A Belfroid. 2000. Bioavailability in soil or sediment: exposure of different organisms and approaches to study it. *Environment Pollut* 108: 113-119.

Silahooy Ch. 2008. Efek pupuk KCl dan SP-36 terhadap kalium tersedia, serapan kalium dan hasil kacang tanah (*Arachis hypogaea* L.) pada tanah brunizem. *J Agronomi* 36: 126-132. (in Indonesian).

Stein T-M. 1990. Development of design criteria for pitcher irrigation. *Cranfield Institute of Technology*. Silsoe College. The UK. [Disertation].

Stewart WM, JS Reiter and DR Krieg. 2005. Cotton response to multiple applications of phosphorus fertilizer. *Better Crops* 89: 18-20.

Telkar SG, K Kant, S Pratap and S Solanki. 2017. Effect of mulching on soil moisture conservation. *Biomolecule Reports* 9: 1-4.

Tibebu T, K Tesfaye and K Woldetsadik. 2011. Clay pot irrigation for tomato (Lycopersicon esculentum Mill) production in the north east semiarid region of Ethiopia. *J Agr Rural Dev Trop* 112: 11-18.

Woldu Z. 2015. Clay Pot Pitcher Irrigation: A Sustainable and socially inclusive option for homestead fruit production under dryland environments in Ethiopia (A partial review). *J Biology Agriculture Healthcare* 5: 157-167.

Wang X and Y Xing. 2016. Effects of mulching and nitrogen on soil nitrate-N distribution, leaching and nitrogen use efficiency of maize (*Zea mays* L.). *PLoS One* 11: e0161612.