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Impact of Soil Water Quality on Yield, Qualities and Water Consumptive Use of Melon (Cucumis Melo L)

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Abstract*—Indonesia has two seasons. These are wet season and dry season; in the dry season, water from rainfall decreases and demand for water as irrigation resources decrease. Soil water is expected to supply irrigation in the agriculture sector. Water quality at Universitas Padjadjaran can be affected by poor water disposal planning and the location of the surrounding industrial estate, animal farms, farm activities and domestic wastewater. Poor water quality can affect the quality and quantity of crops. Melon is commonly not needed much water as a consumptive use but needs water in whole life and usually applied irrigated, especially if growth in the greenhouse. Poorly applied water qualities of the melon can will impact the quality and quantity to decrease. Research on the impact of soil water quality on yield and quality and consumptive use of melon was conducted at the greenhouse located in Universitas Padjadjaran Campus, West Java Province, Indonesia, from July to November 2019. The research method is descriptive analysis, and melon is planted in containers called autopot and fertigation daily applied by control of autopot smart valve. The results show that TSS of soil water were 200.2 mg/al; TDS 300.2 mg/L; EC 0.75 mS/cm; pH 7,0 and turbidity is 4.75 NTU. The quality of melon shows that water 95.19%; Fat 0.88%; ash 0.57%; protein 1.37%; carbohydrate 1.99% vitamin C 6.91% and sweeteners is 9.4 Brix. In conclusion, that soil water meets requirements as resources irrigation to applied melon.

Keywords—autopot; fertigation; water quality and irrigation.

I. INTRODUCTION

Actual supplies of water for irrigation came from rainfall, soil water; check dam and river. The demand for more water resources is related to irrigation for food supply, and about 250 million hectares are under irrigation; there so a great need to improved ways of applying more enjoyable quality of water [1]. In the dry season, crops generally will experience water shortages; the reason is that crops have limited water supply from rainfall; while consumptive use of water should be enough for water requirement into plant grows. One of the alternative technologies that soil water can be provided as a source of water irrigation in the dry season. Source of irrigation water from soil water in agriculture needs to consider which are soil, climate, hydrological and sociological potential [2].

The problem of soil water qualities as a resource of irrigation, especially in Jatinangor campus of Universitas Padjadjaran, West Java should be investigated due to poor planning of industrial sites, e.g. animal farms, feed fish, farmer activities and water from domestic waste. Need to improve and watch the wastewater treatment system and to make sure that work so competent so that effluent can be and is reused, e.g., for resources of irrigation for crops [3].

Agriculture waste management, e.g., from animal wastes to be treated by composting or biogas production. Poor soil and Water quality can affect crop yields and quality; it should be positive, right and safe when applied to the crops; and impact to decrease yield [4]. The strategy of management to implement irrigation water quality is to improve soil water quality. Irrigation water resources from soil water for crops is used effectively and safely from some pollutants. For example, soil or water can have microorganisms that can interfere with human health, so plants grown in contaminated land can produce contaminated food. This means that these foods will indirectly cause disease in humans [5].

Melon (Cucumis melo L) needs irrigation water whole life primarily when it grew in the greenhouse, and the source of soil water irrigation should be assessed. Irrigation quality from soil water for melon crops in the greenhouse was the impact of melon's quality and production. Melon is a crop that is sensitive to the amount of water given [6]. The periods most affected by the amount of water supplied are during flowering and fruiting, whereas during the ripening period, water shortages do not substantially affect the yield of melons and their quality [7].

A. Application of Soil Water as Source of Irrigation Using Autopot

Agriculture is the most significant user of water, is directly concerned with the increasing water demand. Rice is the highest user of water in Indonesia, which is one litre/hectare/second and use of surface irrigation method. Non-agricultural uses of water such as industrial, recreational and domestic need; their demand for a share of the limited water supplies of the nation, it will become increasingly crucial for agriculture to improve the efficiency of water supply. In general, irrigation methods were (i) surface irrigation, (ii) subsurface irrigation, (iii) sprinkler irrigation and (iv) drip irrigation [8].

Melon is commonly not needed much water as consumptive water use in whole life and usually applied irrigated by drip irrigation methods. In this research, irrigation method considerably subsurface irrigation, but irrigation water requirements are applied to an autopot from small torrents through a small pipe from the torrents in the greenhouse without electrical energy and water use efficiency rise by using its method.

The soil water as a resource of irrigation for melon daily applied control by the smart valve of autopot over subsurface irrigation. Water in the ground can be collected in storage such as ponds or torrents and used as a source of fertigation water, especially in the dry season. The advantages to applied its technology were researcher did not need to control irrigation water daily because the autopot with smart valve is fully automated control irrigation and become more straight forward and less laborious [9].

Water and nutrition are basic needs for plant growth; the technique used to drain dissolved minerals and irrigation using irrigation water. Nowadays, fertigation is increasingly being used because the nutrients used are more efficient, use less labour and have enormous potential to control crops. Advantages of fertigation include:

- Minimize fertilizer application time because it does not require fertilizers and low labour requirements
- Potential to reduce the amount of loss of fertilizer that flows down the root zone
- The root zone absorbs more nutrients because of smaller drainage holes [1].

The autopot system is the latest technology, efficient and environmentally friendly that revolves around the smart valve and allows for sustainable and consistent crop cultivation, which it could not become independent of soil, especially if crops grown in the greenhouse. Crops are protected from diseases and also are kept greenhouse clean [5]. Autopot is an irrigation system itself and is an automated system technology that does not require electrical energy to distribute water and nutrients to plants.

Applied of soil water as source irrigation for melon combined with the autopot may could efficient of water consumptive use and increase quality and yield of melon; because crops are protected from diseases and are kept healthy [10]. The combined system of fertigation and autopot is a new alternative system used to increase melon production. Some of the reasons using the system are that melons do not depend on the soil to grow, melons can develop well in a greenhouse environment, efficient of consumptive water caused by the absence of water wasted from autopot.

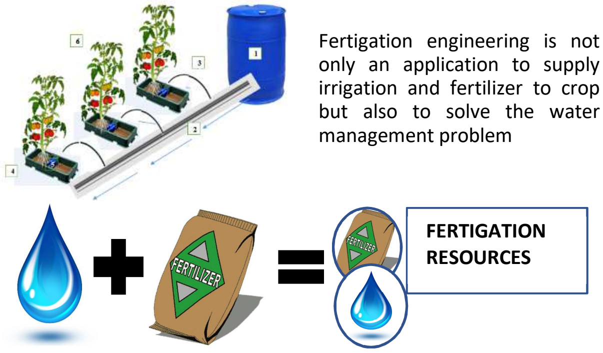

Fig. 1 Mechanism Fertigation Engineering for Crop in Green House

B. Soil Water Problems As Sources Of Irrigation

Nowadays, water pollution is one of the most severe environmental problems in many parts of the word. This is caused by the discharge of various kinds of pollution without adequate treatment in its receiving waters. An increase in the use of chemicals in various activities, including agriculture and industries, as well as domestic use, is one leading cause of these pollution problems. Management of water quality requires a multidisciplinary concept covering both technical and social means. Technical means include physical and ecological measures, while social means comprise public awareness and participation, organization and regulation [11].

The most suitable quality of water for irrigation resources come from rainfall because rainfall delivers high-quality and clean from soil particle and pollutants. Water quality for agriculture was dealing with low quality; the problem of water absorption by the soil that is related to water quality generally is pH and electronic conductivity (EC). Plants irrigated with irrigation are very dependent on the adequacy of water supplies with good quality [5].

Water quality refers to the characteristics of water supply that will influence its suitable for a specific use [12]. Soil water quality is defined by physical, chemical, and biological characteristics. Water quality problem in irrigated agriculture from soil water for an instant from water infiltration rate is relatively excessive sodium or lack of calcium in water or soil will reduce the rate of absorption, which results in plants becoming lack of water adequately from one irrigation to the rest [13]. There are several factors to be considered of water quality for irrigation, such as pH, EC and TDL and TSS. TABLE below gave of the guideline for soil water irrigation.

TABLE I
THE GUIDELINE OF SOIL WATER IRRIGATION

Potential Irrigation Problem	Unit	None	Slight to Moderate	Severe
EC (Electronic Conductivity)	ds/m	0.7	0.7 - 3.0	> 3.0
TDS	mg/L	< 450	450 – 2000	> 2000
pH	Normal range 6.5 – 8.4			

(Source: [12])

TABLE above shows that water quality is typically or slight to moderate can be applied to the crops, but need assessment how are the qualities of soil water as an irrigation impact for quality and yield on melon. Plants in the hydroculture system can absorb at pH between 5.5 to 6.5 precisely between 5.5-5.8. Therefore the pH value of melon plants in this study is still within its threshold value [14].

The pH value in this range is beneficial for the absorption of water and nutrients in melon plants. The absorption is the entry of ions into the root cell so that one ion affects the other ions. Besides, the quality of water with a pH value that is very helpful for active absorption in water absorption. The process of active absorption in water absorption of melon plants, starting from root hairs that develop well. Therefore, pH is a very process of absorption and translocation in melon plants in the absorption of water and nutrients. A well-developed root structure greatly influences this absorption [15].

pH is beneficial in the process of translocation of water and minerals. Melon plants can easily absorb water through the root hairs which are allocated by the stem vessels. The impact illustrated is that root pressure dramatically helps the process of plant growth. Therefore, the availability and quality of water help the process of photosynthesis in melon plants substantially. This shows that water can regulate the rate of photosynthesis and circulate the results to help the process of absorption and translocation. Figure 1 below shows that the pH availability range in hydroponics [16].

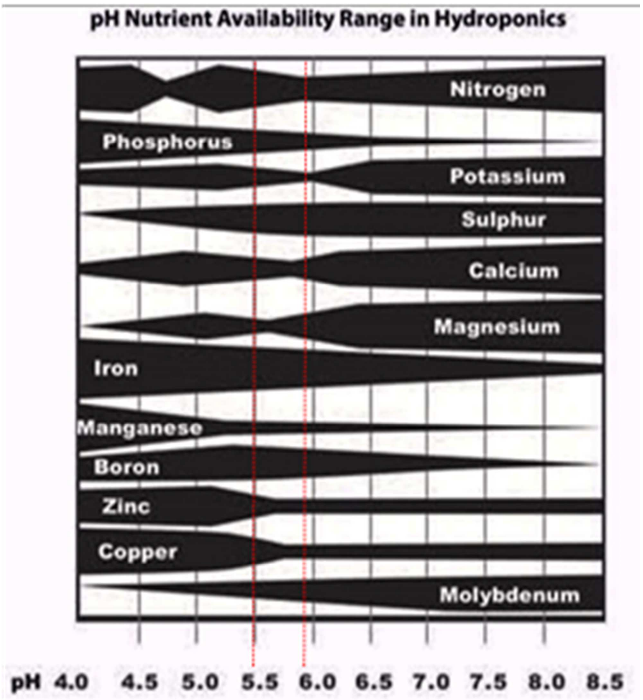

Fig. 2 pH Nutrient Availabilities in Hydroponics Source: [17]

Melon needs pH between 6 to 7; Total Dissolved Solids (TDS) > 200 mg/lt; Total suspended Solids (TSS) 100 mg/lt; pH between 6 to 7, and Electrical Conductivity (EC) depend on the growing stage. The initial stage of melon needs the EC was one mS/cm and 2.5 mS/cm for the growing stage [17]. Poor quality of irrigation water will affect the quality of melon such as ash, carbohydrate; sweeteners; vitamin C and protein [18]. PH and EC are two crucial factors determining the sustainability of soil water quality for irrigation of melon. In the case of pH, irrigation water for melon should have > 6.

A pH is a measure of the concentration of hydrogen ion in water or other liquid. Irrigating water with pH below seven is term acidic, while pH above 7 is term basic; for melon pH seven is neutral [19]. Irrigation quality should always include both pH and alkalinity. However, in most irrigating water, a pH causes no problems if the alkalinity is low. This condition would cause an advantage if soil water quality for irrigation applied to the melon crop in the greenhouse [20].

If applied irrigation water from soil water, which are some problems, e.g. chemical and physical, for example, EC, is a significant chemical problem but can be removed by several water purification systems [21]. pH affects the concentration of ions in water, and it will affect the value of the concentration of electrical conductivity (EC). If the EC value in the initial conditions of planting decreases when reversed, then the root function of absorbing nutrients functions well. If the value of EC concentration remains when nutrients are applied to plants, then the function of the roots is disturbed to absorb nutrients. The average value of the components of the total dissolved solids of the fruits was significantly different in the two brix. Therefore, with an EC concentration value of 2,5 mS/cm, the ion is absorbed with efficiency in the use of nutrients in absorbing nutrients and nutrient requirements in melon plants. The EC concentration value indicates sufficient concentration for the melon plant to absorb nutrients optimally. Physical problems on soil water for irrigation quality were turbidity due to sedimentation and soil particles [22].

II. Materials and Methods

The research was carried out at the greenhouse located in Universitas Padjadjaran campus, Jatinangor Sumedang, West Java Province, Indonesia; is on 6’48’LS and 107’21’ BT with an elevation of 753,96 m a.s.l with an average temperature 18-30 ^{o}C and humidity of 85 93% The research method is descriptive analysis, i.e., analyzing data quantitatively and investigating the link between the soil water qualities on consumptive water use; soil water qualities and melon’s qualities were melon planted in on the autopot with growth media uses mixed of charcoal husk combined with zeolite with ratio 9:1 and 15 cm height [7]

Soil water used to collect from the soil and stored to a water tank or in the big torrents, which each torrent content 5300 litres and in this research, had four torrents available. From big torrents, soil water delivered into small torrents in the greenhouse and combined with mineral nutrient or called fertigation and the end of irrigation supplying to melon crops with growth in autopot through at the small pipe [5].

The research observed are as follows:

- Soil water quality is analyzed in the ecology laboratory at Padjadjaran University. The soil and water analysis were TDS; EC; pH; TSS and turbidity,
- The quality of melon is analyzed in Food Technology Laboratory of Padjadjaran University; expressed which are ash; fat; water; protein; Vit C; sweetness and carbohydrate,

- Water consumptive use per growing stages of melon, which are initial stage; development stage; mid-season and final season. The calculated water consumptive use is from the reduction of water in the small torrents.

III. Results and Discussion

A. Soil and Water Quality

The quality of soil water results showed in TABLE .

TABLE II
Soil Water Quality

No.	Parameter	Unit	Analysis Results
1.	TSS	mg/L	200,2
2.	TDS	mg/L	300,2
3.	DHL/EC	mS/cm	0.75
4.	pH	-	7.0
5.	Turbidity	NTU	4.78

TABLE shows that TDS is 300.2 mg/l; it is mean shallow less than 450 mg/l; EC 0.75 mS/cm this slight and moderate; according to the guidelines of soil water irrigation from [12] all results still suitable for melon in the initial stage. The pH of soil water quality is 7.0 suitable for growing melon crops.

B. The Quality of Melon

Melon quality parameter analysis expressed are water; fat; ash; protein, carbohydrate; vitamin C and sweetener. TABLE III shows that analysis of melon's quality as below:

TABLE III
Quality of Melon

No.	Parameter	Unit	Result Analysis
1.	Water	%	95.19
2.	Fat	%	0.88
3.	Ash	%	0.57
4.	Protein	%	1.37
5.	Carbohydrate	%	1.99
6.	Vitamin C	%	6.91
7.	Sweeteners	0Brix	9.4

TABLE III showed that water 95.19%; fat 0.88%; ash 0.57%; protein 1.37%; carbohydrate 1.99%; vitamin C 6.91% and sweeteners 9.4% 0Brix. When compared to research [9] data, that water in melon good on 93%; it means soil water irrigation good enough as irrigation resources for melon quality. The other parameters, for example, ash; melon is a good quality when ash 0.45%, while research results are 0.57%. In other words, quality of melon is good. Protein 1.3% [12] noted that melon with 0.6% in category good; in this results from the analysis, quality protein of melon excellent. Vitamin C in this research still low, only 6.9%; melon with vitamin C is good in the less 20-25%. Vitamin C is not stable in the crops, for example, due to the life of storage. Sweetness is 10%; results from SNI 7883-2013 that sweetens of melon should be 10%, the other words quality of melon with applied soil water irrigation is good. Over all the quality of melon and use soil water resources for irrigation is good.

C. Consumptive Used of Melon Per Growing Stage

Consumptive use is the quantity of water used by the vegetation growth of a green area or amount of water required by a crop for its vegetated growth to evapotranspiration and building of plant tissues plus evaporation from soils and intercepted precipitation [23]. Consumptive use varies depending on temperature, humidity, wind, topography, sunlight hours, method of irrigation, and moisture availability. Consumptive use also affected by many management and natural factors and can usually be controlled, although there are many interrelated natural factors. They include water supply quality, planting date, crop variety, fertility, plant space, irrigating scheduling, cultivation and chemical spraying [24].

Crop evapotranspiration which the amount of water that is lost through evaporation and transpiration. Estimation of evapotranspiration is essential for the agriculture water requirement, also important irrigation planning and scheduling, as is in an interval part of the field management decision support tool. Estimation of evapotranspiration expressed [25] is:

$$Etc. = Kc.Eto \tag{1}$$

Where:

ETc: crop evapotranspiration (mm/day)
Kc: is the crop coefficient for the crop
ETo: crop evapotranspiration reference (mm/day)

Table 4 below shows the results of consumptive water use of melon on the growing stage

TABLE IV
Consumptive used of Melonon Gnr Gowing Stage

Growing Stage	Length of Days	Total Consumptive Use (Litre)	Consumptive Use Per Crop (Litre)
Initial	16	4.00	0.07
Development	20	382.40	6.37
Mid Season	37	1858.90	30.98
Late Season	16	874.00	14.57
Total	89	3119.30	51.99

TABLE showed that consumptive use low in the initial stage only 4 litres during 16 days and would rise in the development stage, which is 382.40 litre during 20 days; its mean melon starts to grow up until the generative phase. Water consumptive use in the mid-season stage was 1,858.90 litre with 37 days (the highest one). In this stage, melon growing in the generative stage, e.g. flowering and the late-season stage, were water consumptive use decrease become 874.00 litres during 16 days. Total consumptive use for melon was 3119.30 litre; this results very efficiently compared to previous data [12]. The use of water to meet the water needs of melon plants without using autopot is 6,000 litres. The reason is that melon growth using autopot technology is more efficient due to the absence of water discharges or spills emanating from autopot [1]. Figure 2 shows the graph of the total consumptive use of melon.

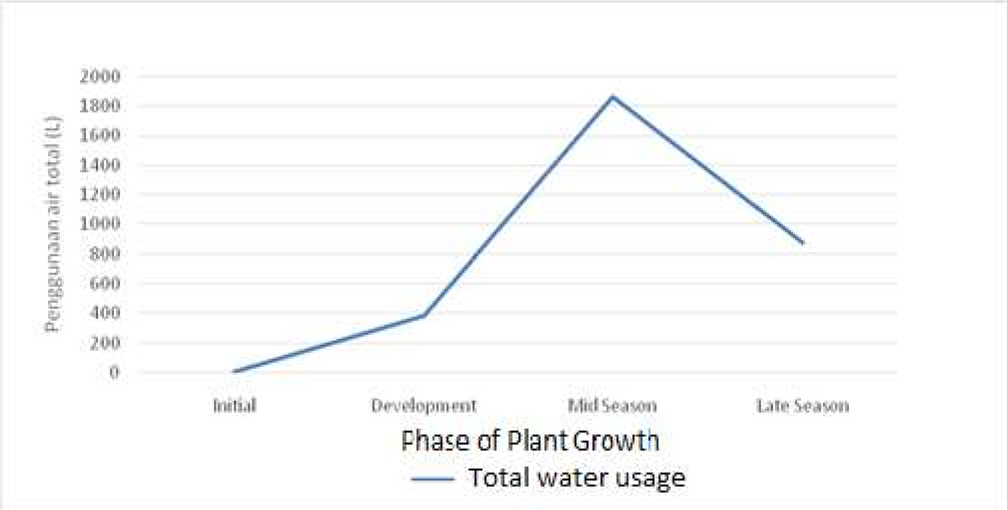

Fig. 3 Total Water Consumptive Use Per Growing Stage

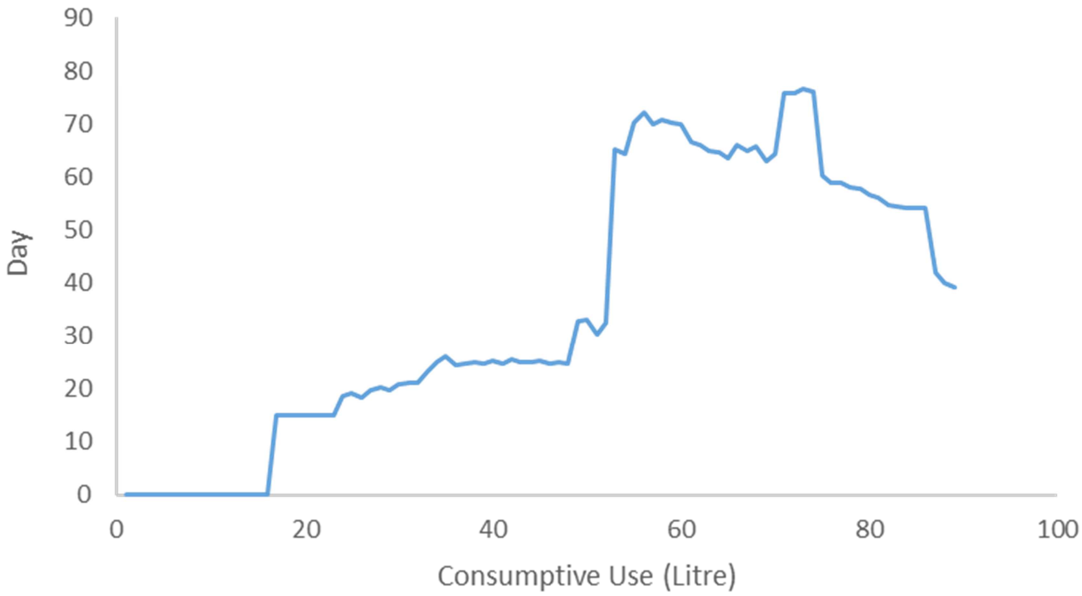

Fig. 4 Total water consumptive use daily

IV. Conclusion

Based on the research observation that has been conducted, it can be summed up as follows: The soil water quality potential and good enough if applied it as resources of irrigation for melon were TDL 220.4 mg/L; TSS 320.2 mg/L; EC 0.75 mS/cm; pH 7.0 and turbidity 4.78 NTU. Impact of soil water on melon's quality which are water is 95.19%; fat 0.88%; ash 0.57%; protein 1.37%; carbohydrate 1.99; vitamin C 1.99% and sweetness 9.30 Brix. Water consumptive used per the growing stage low in the initial stage and peak in flowering or started with 70 days. Total consumptive used per plant were 51,93/liter more efficiently if compared with melon growth without used autopot. In conclusion, soil water qualities from Universitas Padjadjaran campus can be able to apply it as the water used during dry as a resource of irrigation, consumptive use, yield, and qualities of melon.

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