Impact of Cycocel and Irrigation Levels on Growth Characteristics of Lawn Grass

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Abstract

A study conducted at the University of Raparin in Sulaimani province aimed to assess the effects of the plant growth regulator cycocel on various parameters of lawn growth. Spanning two seasons, from April 2021 to October 2022, the study took place in the field of the College of Agricultural Engineering Sciences. The seed utilized in the experiment was a blend comprising 40% Festuca arundinacea, 10% Poa pratensis, 40% Festuca arundinacea, and 10% Lolium perenne. The research involved three concentration levels of cycocel (0, 100, and 200 ppm) applied as foliar sprays during the plants' rapid growth phase. Additionally, three irrigation levels (A1, A2, and A3) were implemented, representing 100%, 80%, and 60% of the reference evapotranspiration (ETo), respectively. The findings revealed that the application of a 200 ppm cycocel foliar spray led to an increase in proline content compared to the control group under non-stressed conditions. Specifically, the lawn length was lowest in the treatment with 200 ppm cycocel (13.914 cm), whereas the control group exhibited the highest length (16.807 cm). Similarly, the control treatment showed the highest fresh weight (572.654 g) and dry weight (284.000 g), while the 200 ppm cycocel concentration yielded the lowest values (395.288 g and 260.740 g, respectively). Statistical analysis of the data indicated significant variations ($p \leq 0.05$) in lawn growth resulting from different irrigation levels. The highest lawn height (16.08 cm) was observed in A1, whereas the lowest height (15.277 cm) was recorded in A2. Furthermore, significant differences were observed in fresh weight, with the A2 group exhibiting the highest value (522.67 g), while the A1 and A3 groups recorded 502.07 g and 404.72 g, respectively. Notably, a significant difference in dry weight was observed between the A1 (302.81 g) and A2 (306.96 g) irrigation levels. Proline content also varied across irrigation levels, with the A3 level recording 16.59 mg g^{-1} fw, and the A1 and A2 levels showing 13.201 mg g^{-1} fw and 12.81 mg g^{-1} fw, respectively.

Keywords: Lawn Grass; Cycocel; Proline Content ; Irrigation Levels; Seed Mixture.

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Introduction

Lawns, like any herbal plant, can thrive when they are trimmed at a low enough component and cover green above the soil surface (Jonhnson, 1996), or in those locations where a diversity of herbal plants are grown next to one another. When branches are removed, they spread out lavishly to fill the space between the plants that were sown, and when the growth is combined, it takes on an appealing shape like a green carpet. lawn gives a place for children to play, add oxygen to the air, cools the surroundings, prevents soil erosion, and adds to the worth of a house or company (Stier, 2008).The practice of landscaping was originally recognized in England in the thirteenth century and has since been a fundamental part of the discipline.

Our present major portion of running green spaces is 70–80% of the size of the majority of the land in public and private gardens, parks, highways, squares, or sports stadiums, and is in the art of landscaping the center and principal corner of the park (Baali, 1967).

In recent years, irrigation systems have been under pressure to produce more with less water. Water withdrawal, energy consumption, pollutants, and other environmental burdens, can be reduced through innovative methods. Technology can be better used by farmers, more technologies can be adopted, soil and water management skills can be improved, and crop patterns can be adapted to meet the needs of the farmer. Agricultural inputs, water consumption, etc., should be reduced. It is possible to increase aquaculture's economic viability and environmental sustainability without needing to reduce its water consumption by using water-efficient practices. The experts have developed various models for water efficiency to understand these practices, but farmers rarely use them.

One of the smaller segments in the agricultural chemical business is plant growth regulators. They are substances that affect plant development and metabolism in a positive way and have a wide range of chemical structures that may be created artificially or naturally (Bhalla and Shehata, 2017). In some turfgrass management methods, the use of plant growth regulators or inhibitors is now considered standard practice. Regular mowing is necessary to preserve high-quality sports turf, such as that seen on golf courses. Regular mowing, however, is expensive and time-consuming. Therefore, to reduce mowing frequency and expenses, turfgrass managers frequently utilize plant growth regulators to restrict both vegetative growth and seed head emergence. Many frequently used plant growth regulators work by preventing the formation of gibberellin. Consequently, cell elongation is decreased (Abdel-Kader and Abdalla, 2003). Therefore, mowing frequency can be greatly reduced by a decline in growth.

Tolbert (1960) was the first to note the effectiveness of cyclocel (2-chloroethyltrimethylammonium chloride), sometimes known as CCC, in lowering plant size and giving plants a deeper green hue. According to Luo et al. (2011), Cycocel lowers the fresh and dry weight of grass and appears to do so through reducing the plant's auxin level.

Material and methodology

Experimental site description

This experiment was conducted at the *Qaladiza* city , locating on 120 Km north of *Sulaimania* city, *Kurdistan* region, *Iraq*, with 36º 10' 19" N; Latitude, 45º 8' 17" E; Longitude, and Altitude 576 meters above sea level (masl). The study location was appointed by GPS and *Google earth*. a: *World*; b: *Iraq*; c: *Sulaimania*; q: *qaladiza* as shown in Fig. (1).

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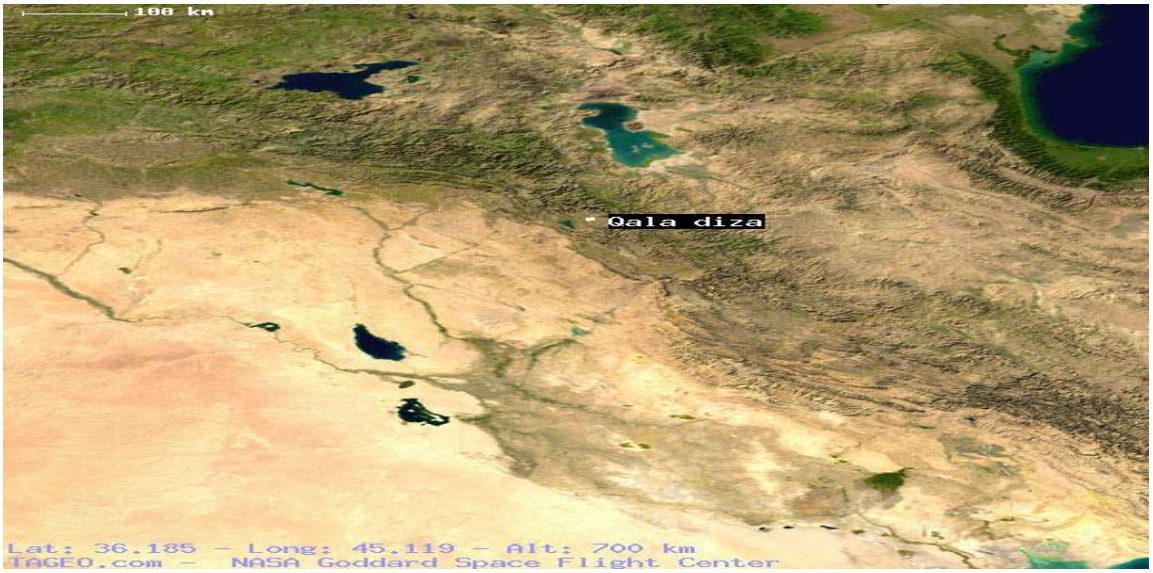


Fig(1) Qaladiza location

It was carried out at University of Raparen, field of the college of Agriculture, Pishdar Region, located in Sulaimani province, during the two seasons fall and spring, from the April 2021 to October 2022. The seed that used is four types 40% Festuca arundinacea , 10% Poa pratensis , 40% Festuca arundinacea , 10% lolium perenne . The maximum and minimum temperature and humidity for the experiment location are records by use thermo hydrograph table .

Seed mixture

The source of seed used mixes ready seed varieties turf season cold, which was obtained from the offices of Agricultural Sulaimani from Lebanon mountain mind that it was certified and packed bags and each card indicating the percentages (calculated on the basis of weight) of seeds of each type or class within the mixture as well as the rate of seed per unit area for each mixture are according the recommendation of the company.

Irrigation system

The irrigation system is the sprinkler that consists of the pump, delivery pipe and sprinklers. Connecting pipes were placed, and each blot contains 8 sprinklers, the distance between two sprinklers is 3.25 m, therefore the total number of sprinklers is 24, and they are operated separately so that the pressure is equal in all the plots.

Experimental design

The experiment consist of

1- Three level of irrigation (100% , 80% and 60%)
2- Three level of Cycocel (0, 100 and 200) ppm

. So that the Experimental Design: A factorial experiment was laid out in split-split plot design.

Fig(2)Experiment design

Soil analysis

Studies of employed soils: According to Sparks et al. (2020) and Dane and Topp (2020), certain physical and chemical characteristics of the initial soils used (alluvial and sandy soils) are presented in Table (1), where their studies were carried out as standard work.

Measured Properties		Amount	Units
Electrical Conductivity EC 1:1		0.2	dsm-1
pH 1:1		7.14	----
Available N		21.0	mg kg^{-1} soil
Available P		8.21	
Available K		76.51	
Soil Organic Matter		4.01	gm kg^{-1}
Calcium Carbonate $Caco_3$		278.2	
Dissolved Ca^{+2}		3.51	meq lit^{-1}
Dissolved Mg^{+2}		2.19	
Dissolved Na^{+}		1.12	
Dissolved Bicarbonate Hco_3		0.82	
Dissolved Cl		2.91	
Dissolved K		0.33	
Texture Class		Silt Loam	
Soil Particles	Sand	% 37.2	
	Clay	% 10.8	
	Silt	% 52.0	

Table (1) soil analysis

Cycocel spray

Cycocel were added every 15 days (Anayat et al.,2020) that were used handle sprinkler for each treatment . The first year needed 9 sprinkler and the second year needed 11 sprinkler

Study parameters

Plant Length (cm)

Plant Length was measured during the probationary period. The length measured by measuring ruler.

Fresh Weight of clipping (gm)

Fresh weight calculate during each mowing, The clipping collected and weighted by balance of wight .

Dry Weight of clipping (gm)

The fresh clipping that produce in the mowing after balance putted in the oven Temperature 70˚C. After 2 days the clipping balance again without mix them every treatment calculated individually

Quantity of irrigation water / liter / year

Pan evaporation method

A practical method for determining reference evapotranspiration ETo is the pan evaporation method. This approach combines the effects of temperature, humidity, wind speed and sunshine.

The evaporation from the pan is very near to evapotranspiration of grass that is taken as an index of ETo. The pan direct readings (Epan) are related to the ETo with the aid of the pan coefficient (Kp), which depends on the type of pan, its location (surrounding with or without ground cover vegetation) and the climate (humidity and wind speed).

$$ETo = Epan \times Kp$$

Table (2) Number of irrigations, rainfall, and irrigation amounts applied for different irrigation treatments in the first year:

periods	No. of irrigations	Rainfall (mm)	A_1 (mm)	A_2 (mm)	A_3 (mm)
0 to 0, April	0	0	0	0	0
9 to 31, May	23	1.4	138	110.4	82.8
1 to 30, June	30	0	221.6	192	144
1 to 31, July	31	0	292	233.6	175.2
1 to 31, August	31	10.8	294	235.2	176.4
1to 30, September	30	0	229	183.2	137.4
1 to 31, October	31	25.8	170	136	102
1 to 7, November	7	0.4	28	22.4	16.8

Fig(3) lawn growth

Proline content

Determination of proline in the leaves Proline was estimated according to the method of Bates et al. (1970),

Result and discussion

Plant length

Height of plants as a result of cycocel (cm/plant), the data shown in (Table 3) show that the use of cycocel had a substantial impact on plant height (cm/plant).. Generally, plant height decreased linearly with increasing cycocel concentrations. Throughout the seasons, untreated plants produced the tallest plants. However, it is evident that the amount shoot elongation was reduced in comparison to the control depended on the pace at which cycocel was applied to plants. Cycocel spray doses increased up to 200 ppm resulted in a noticeable reduction in plant height when compared to the other treatments or the control. The average plant heights with dosages of 0, 100, and 200 ppm in the cycocel treatments were 0.07, 0.06, and 0.04cm/plant, respectively..

According to Magnitskiy et al. (2006), the growth retardant's effect on slowing down cell division and limiting cell expansion appears to be the source of the extraordinary reduction of plant height caused by its application. Additionally, it has been hypothesized that cycocel contains anti-gibberellins dwarfing agents, causing a lack of gibberellins and ultimately impeding the first stage in the synthesis of gibberellins, the conversion of geranial pyrophosphate to capably I-pyrophosphate. In light of this, it is possible that the decrease in plant height is caused by the slowing of transverse cell division, notably in the stellar cambium, the region of meristematic activity near the base of the internodes (Grossman, 1990; Fisher et al.,1996; Karunananda and Peiris, 2010).

Moreover in table (4) showed that irrigation level 100% had significant effect on plant length that was 16.08cm and 80% , 60% was 14.83 and 15.27 consequently .This result is in agreement with Mohamed H. Abd el-wahed et al. (2015), Jajarmi (2009), Fattah (2009), and Najy (2009), as well as Ayotamuno et al. (2007) and Sammis et al. (1988) found on the ability of plants to adjust their height in response to varying degrees of water scarcity. The decrease in plant leaf area and the reduction in nitrogen absorption and assimilation, which slows down photosynthesis, are the causes of the decrease in plant height (Grismer, 2001). When there is insufficient water in the root zone, this process will lead to the accumulation of abscisic acid and proline (Showler, 2002) in the xylem, decreasing water transport. So, by partially or completely closing its stomata, the plant will lessen the amount of water lost through transpiration

Effect of cycocel on fresh and dry weights ($g.cm^{-3}$).

According to Table 3, the rsult of fresh and dry weights ($g.cm^{-3}$) changed significantly throughout each of the two following seasons as a result of the effects of cycocel treatments. When compared to the control, the application of cycocel treatments at various amounts caused a significant reduction in fresh and dry weights ($g.cm^{-3}$). The highest value of fresh weight, in the first season, was recorded with untreated plants. The lowest value of fresh weight, however, was recorded with cycocel at a rate of 200 ppm (395.28 g.cm-3), followed by cycocel at a rate of 100 ppm, which recorded 461.53 g.cm-3.

On the other hand, dry weights continuously decreased when cycocel levels were increased. The lowest dry weight value was obtained during treatments using 200 ppm of cycocel (260.74 g.cm-3), which was followed by treatments using 100 ppm of cycocel (273.85 g.cm-3). Comparatively, the first season Table (4) showed that the untreated plants had the maximum dry weight (284 g.cm-3). The same tendency was seen in season two. Developmental inhibitors limit stem elongation, inhibit growth as a whole, and reduce the production of shoot biomass, which lowers fresh and dry weights (Alem, 2014). These results agree with Hill (2004) and Al Shaer (2004) on the Rudbeckia hirta plant and Grindelia camporum, respectively.

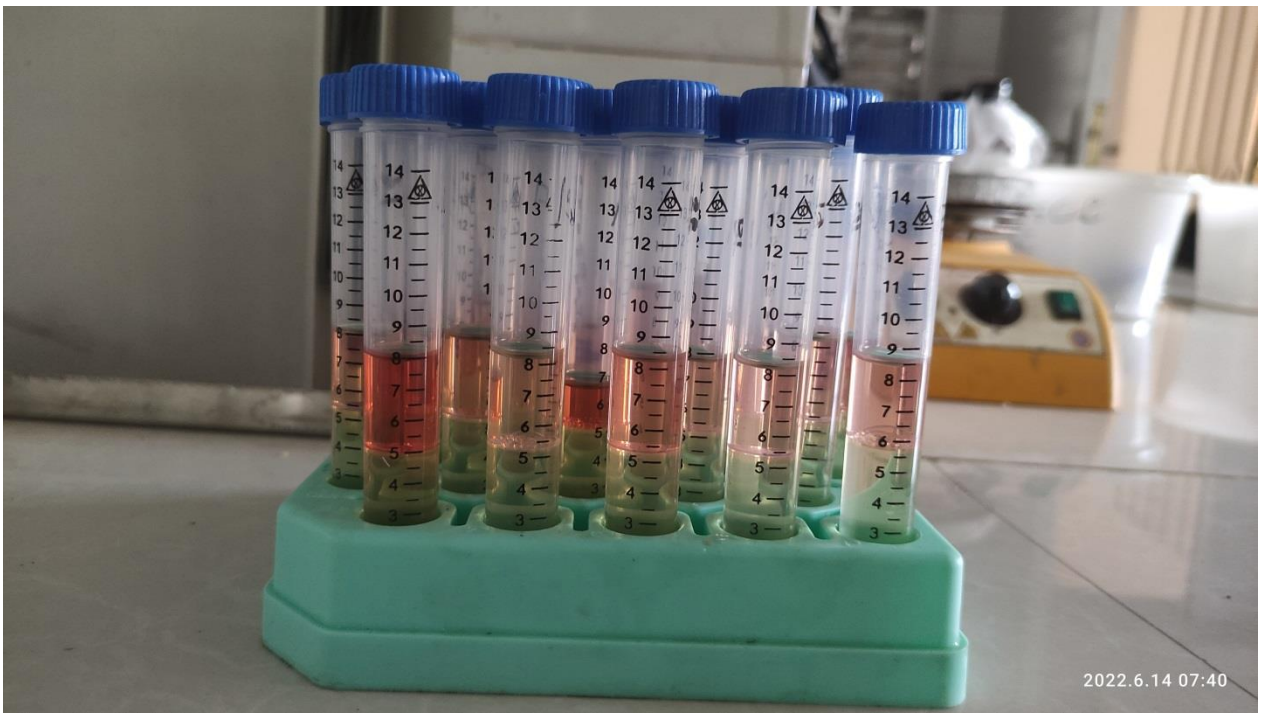
Prolin content

Table (3) showed that treatment using 200ppm cycoccel resulted in the highest value of prolin content that was (16.98 $mg.g^{-1}$) which was followed by treatment using 100ppm which recoded (14.122 $mg.g^{-1}$).The lowest value of prolin, however, was recorded with control treatment which was (11.502 $mg.g^{-1}$).

This is because the addition of Cycoccel increases the building of some organic compounds, especially the amino acid proline, the protective factor for enzymes, which maintains the structures of cellular membranes, increases the vitality of plants, and reduces the absorption of harmful ions, Which helps them to resist the stresses they are exposed to due to the presence of Trimethyl ammonium in the formula of Cycoccel (Budykina et al., 1982).

Table(3) effect of cycoccel on plant length , fresh weight , dry weight and prolin content

Cycoccel(ppm)	**Plant length cm**	**Fresh weight of clipping gm**	**Dry weight of clipping gm**	**Prolin Mg .g -1 fw**
C1	**16.80 a**	**572.65 a**	**284.00 a**	**11.50 c**
C2	**15.47 b**	**461.53 b**	**273.85 b**	**14.12 b**
C3	**13.91 c**	**395.28 c**	**260.74 c**	**16.98 a**



Irrigation effect

Plant length

the result in table (4) showed that irrigation level 100% had significant effect on plant length it was 16.08cm and 80% , 60% was 14.83 and 15.27 .This result is in agreement with Mohamed H. Abd el-wahed et al. (2015), Jajarmi (2009), Fattah (2009), and Najy (2009), as well as Ayotamuno et al. (2007) and Sammis et al. (1988) found on the ability of plants to adjust their height in response to varying degrees of water scarcity. The decrease in plant leaf area and the reduction in nitrogen absorption and assimilation, which slows down photosynthesis, are the causes of the decrease in plant height (Grismer, 2001). When there is insufficient water in the root zone, this process will lead to the accumulation of abscisic acid (Saab et al., 1992) and proline (Showler, 2002) in the xylem, decreasing water transport. So, by partially or completely closing its stomata, the plant will lessen the amount of water lost through transpiration.

Fresh weight and dry weight

In the table (4) showed the effect of irrigation on fresh weight and dry weight the result showed that the level 80% showed significant difference in dry weight and fresh weight that 522.67gm and 306.962 gm respectively. This result is consistent with Fattah's (2009) findings that complete irrigation greatly increased the bulk of dry matter compared to restricted irrigation. Since high air temperatures and low humidity lead plant stomas to shut, assimilation is reduced as a result of a reduced CO2 absorption for photosynthesis. From here, it appears that the plant's dry matter exhibited several traits.

Prolin content

The result in the table (4) effect the level of irrigation on prolin content the result show that for level 60% there was significant difference in this treatment 16.59 $Mg.g^{-1}$ fw , but for the other two level 100% and 80% there was no significant difference between them that was (13.201)$Mg.g^{-1}$, and (12.815)$Mg.g^{-1}$ consequently . These result showed that Proline's significance in plant survival and response to drought stress has been documented by Watanabe et al. (2000) and Saruhan et al. (2006). One potential method for overcoming the osmotic stress brought on by the loss of water has been suggested: osmotic adjustment by the buildup of cellular solutes, such as proline (Caballero et al., 2005). Proline is a non-protein amino acid that is produced in the majority of tissues during water stress and is quickly degraded after drought recovery (Singh et al., 2000).

Proline also functions as an energy sink to control redox potentials, a hydroxyl radical scavenger, a solute that guards macromolecules from denaturation, and a way to lessen cell acidity (Kishor et al., 2005).

Table(4) effect of irrigation on plant length , fresh weight , dry weight and prolin content

Irrigation	Plant length cm	Fresh weight of clipping gm	Dry weight of clipping gm	Prolin Mg .g $^{-1}$ fw
F	16.08 a	502.7 b	302.81 a	13.20 b
E	14.83 c	522.67 a	306.96 a	12.81 b
S	15.27 b	404.72 c	208.81 b	16.59 a

Table(4) effect of irrigation on plant length , fresh weight , dry weight and prolin content.

Quality of water

Sprinkler Irrigation system was used to apply water for all treatments in year 2021-2022 to bring the soil moisture content of the 0-90 cm layer up to the field capacity as Table (4) Precipitation rate during the year.

Three different irrigation treatments (A1,A2 and A3) were applied to the 90 cm root depth depending on soil water depletion replenishments. Symbols A1, A2 and A3 refer to treatments receiving 100%, 80% and 60% soil

Table (4) Precipitation rate during the year

Periods	No. of irrigations	Rainfall (mm)	A_1 (mm)	A_2 (mm)	A_3 (mm)
0 to 0, April	0	0	0	0	0
9 to 31, May	23	1.4	138	110.4	82.8
1 to 30, June	30	0	221.6	192	144
1 to 31, July	31	0	292	233.6	175.2
1 to 31, August	31	10.8	294	235.2	176.4
1to 30, September	30	0	229	183.2	137.4
1 to 31, October	31	25.8	170	136	102
1 to 7, November	7	0.4	28	22.4	16.8

Table (4) Precipitation rate during the year

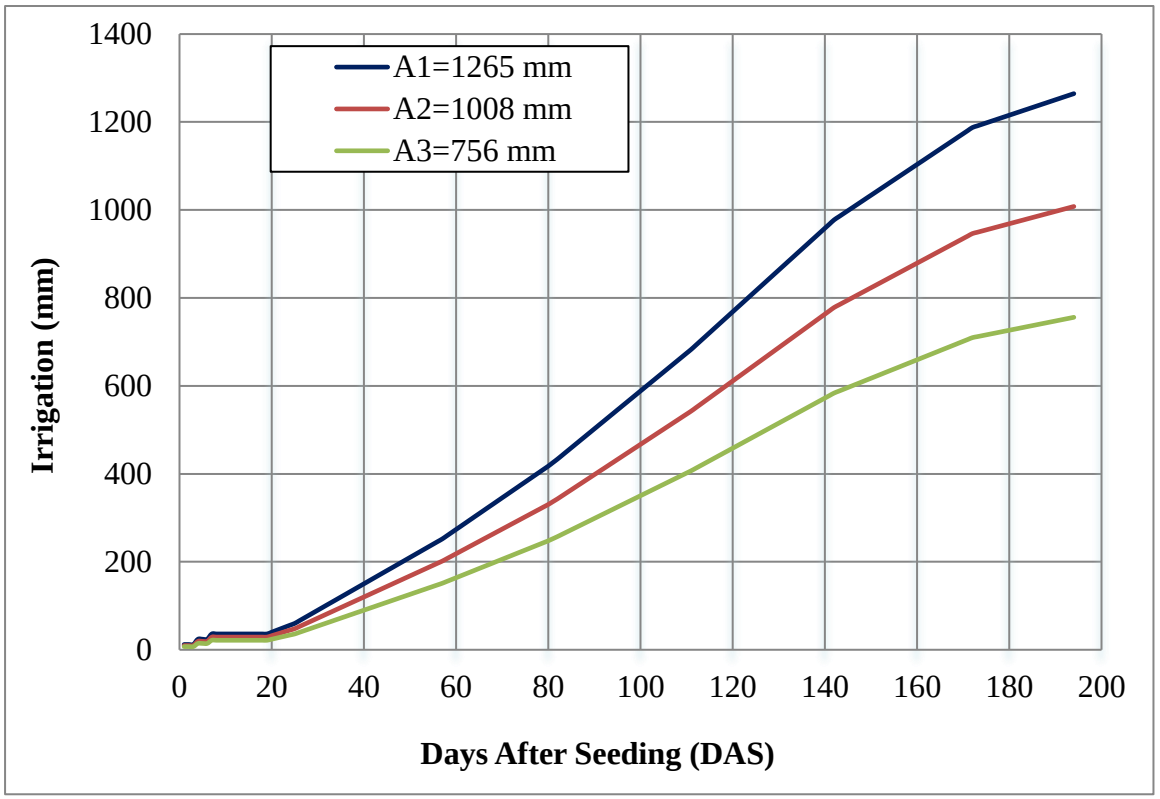


Fig (5) Cumulative depth of water used for different irrigation levels (I0, I1 and I2).

Recommendation

Based on the obtained under the condition of this research the researcher suggests the following recommendation:

1. From the result of this study it can be recommended use height concentration 200ppm of cycoccel led obtain the best results of the most studied.
2. Its preferred to spray cycoccel many times frequently on turfgrass for mowing process of turfgrass.
3. Using irrigation level 100% to get the best result of the most studied.

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