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Effect of Plant Growth Regulator (Cyccocel) and Irrigation on some Vegetative Characteristics of Turffgrass

Berivan Abdulkhalq Ghareeb[1], Ali O. M Sharbazhery[2], Mohammed Abdulrazzaq Fattah[3]

Abstract

A study conducted at the University of Raparin in Sulaimani province Pishdr Region, 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 bulk density compared to the control group under non-stressed conditions. Specifically, the lawn leaf area was height in the treatment with 100 ppm cycocel (0. 82 cm2), whereas the control group exhibited the lowest length (0.54 cm). Similarly, the control treatment showed the highest bulk density that was (76.62 gm/cm3) and plant density value showed significant effect on cycoccel level 200ppm that was 78.66 plant, and for Chlorophyll the treatment 100ppm showed significant effect were it value was (9.87) mg. ml -1 fw, root depth and active root also showed significant effect on treatment 100ppm and 200ppm that was (45.25, 16.44)cm respectively . Statistical analysis of the data indicated significant variations ($p \leq 0.05$) in leaf area resulting from different irrigation levels. The highest leaf area (0.78 cm2) was observed in A1, whereas the lowest leaf area (0.71cm2) was recorded in A2. Furthermore, significant differences were observed in bulk density, with the A1 group exhibiting the highest value (1.13g cm-3), while the A2 and A3 groups recorded 1.02 g cm-3 and 1.09 g cm-3, respectively. Notably, a significant difference in chlorophyll was observed between the A1 (9.73 mg. ml -1 fw) and A2 (9.72 mg. ml -1 fw) irrigation levels. Deep root and active root conten also varied across irrigation levels, with the A1 level recording 47.74cm and 16.87cm consequently , and the A2 and A3 levels showing 44.94cm and 41.34 cm for deep root and 15.64cm 15.26cm for active root respectively.

Keywords: *Lawn; Cycocel; Irrigation; bulk density ; chlorophyll; deep root ; active root.*

[1] University of Raparin/ College of Agricultural Engineering Sciences/ Horticulture Department, E-mail: Berivan.garib@uor.edu.krd
[2] University of Sulaimani/ College of Agricultural Engineering sciences/ Horticulture Department, E-mail: ali.mohamad@univsul.edu.iq
[3] University of Sulaimani/ College of Agricultural Engineering Sciences/ Natural Resources Department, E-mail: Muhammad.fattah@univsul.edu.krd

Introduction

One of the most crucial elements in the cultivation of ornamental plants is controlling plant size. Plant size can be restricted through a variety of techniques, including genetic manipulation, environmental factors, and the use of plant growth inhibitors (Cowling, 2010).

The Lawns as any plant herbal can survive when it is cuts at an altitude of low appropriate component and covers green above the soil surface (Jonhnson, 1996), or those areas cultivated variety of herbal plants adjacent convergent. A healthy lawn provides play area and adds oxygen to our air filters pollutant from air and runoff water, cools the environment, provide soil erosion and increase the value of home or business (Stier, 2008).

According to Sarma and Mishra (1979), Bora and Sarma (2004), and Clark and Fedac (1977), Cycocel is a synthetic growth-retarding chemical that is frequently used to dwarf plants or plant components. Gobhi sarson yield, cotton yield, soybean yield, and wheat protein content all rose with increasing Cycocel concentration (Grewal et al., 1993; Prasad and Prasad, 1994; Bora and Sarma, 2004).

As a result of population growth and economic development, water resources in many parts of the world are pushed to their natural limits; this caused difficulties or impossibilities in using natural water resources especially in agricultural activities. In other words, the adequate food and water cannot be guaranteed for the current and next generations, due to the water shortage and uncertain maintenance of the natural resources (Asuquo and Etim, 2012). Despite the current problems, irrigation has been and remains of vital importance for the provision of food and employment for growing populations worldwide. The agriculture development strategies of most of developing countries depend on the possibility of maintaining, improving and expanding irrigated agriculture.

Material and method

Leaf area index

The leaf area of nondestructive leaf located under the ear leaf directly was determined according to (Saxena and Singh, 1985) using the following relation:

Leaf area = 0.75 (length x width)

Then the leaf area index was calculated by applying the following equation (Coombs et al., 1985).

LAI=(leaf area cm^2)/(area occupied by plant(s)cm^2)

The average of the three LAI from each plot was calculated.

Plant Density (plant/cm2)

Plant density calculate by making square from metal silk it area 225cm2, then randomly throw on the flat to calculate plant number that located in that area of 225cm2,(Jordon,2003).

Root Depth and active root (cm)

Roots depth measured by digging around the sides of the experimental units. The root depth is measured by Measuring Tape. The active root which collects about 50% of the total turff root, active root and root depth measured in the same time (Smith et al.,1999).

Bulk density

Clod method (paraffin-sealed clod). The clod method is the second most widely used technique for measuring soil ρb (Casanova et al., 2016) and is laboratory based (Ali, 2010). This method is also based on the procedures outlined by ISO (2017). In this method

$$\text{Bulk Density (Mg/m3)} = \frac{DW \ x \ ODS}{SA - SPW + PA - (PA \ DW/DP)}$$

DW = Density of water at temperature of determination (Mg/m³)

ODS = Oven dry weight of soil sample (g)

SA = Net weight of soil sample in air (g)

SPW = Net weight of soil sample plus paraffin in water (g)

PA = Weight of paraffin coating in air (g)

DP = Density of paraffin (mg/m³) In this method, soil ρb is measured by calculating soil mass and volume using paraffin wax, saran rubber, or wax mixtures using the following steps. First, a clod is weighed, and then its volume is estimated by coating it in paraffin wax, which is done by heating a wax bath to 65–70 ◦C. natively, the waxed clod is weighed in the air (Ali, 2010).

Total chlorophyll

The extraction of chlorophyll a and b and TC was carried out according to Gross (1991). At the end of each growth stages (GS1 and GS2), the fresh tissue of young and expanded leave collected and freeze at -80ºC then, the leaves (0.25 g) were homogenized with 80% acetone. The optical density (O.D.) of the extracted chlorophyll was measured at 645 and 663 nm by using spectrophotometer PD-303. TC, CHL a and CHL b were calculated by the following formulae (Gross, 1991).

CHLa = (0.0127× OD663) – (0.00269× OD645)

CHLb = (0.0229× OD645) – (0.00468× OD663)

TC = (0.0202× OD645) + (0.00802× OD663)

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.: qaladiza as shown in Fig. (1).

Fig (1): The location of experimental site

Meteorological data and calculation of evapotranspiration

The climate in the region is classified as semi-arid with total annual precipitation of 700 mm. The climatic data during the growing season (April 2021 -October, 2023) were taken from the weather station located nearby the experimental site . (Appendix, 1a).

Also the meteorological data including maximum and minimum daily air temperature, mean daily percentage of annual daytime hours (P) and the daily extraterrestrial radiation (Ra) from the year 2021 up to 2023 were used to calculate reference evapotraspiration (ETo) in mm day-1 for Sulaimania location and listed in appendix (1b) by using original Blaney–Criddle and Hargreaves equations. These data were obtained from Agrometeorological Center.

Then monthly ETc was calculated using the general ETc equation, as the following:

ETc = kc * ETo

Where: ETc = calculated crop evapotranspiration (mm day-1).

kc = Crop coefficient.

ETo = Reference evapotraspiration (mm day-1).

Studied elements:

Irrigation treatments

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. 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 (1) 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

Soil analyses methods:

Physical analyses of soil

Analysis of particle size distribution was carried out by using the pipette and sieving methods (Klute, 1986). Soil bulk density was measured by using core method as described by Blake and Hartge (1986).

Infiltration rate was measured according to Brechtel (1976) as shown in Fig. (2).

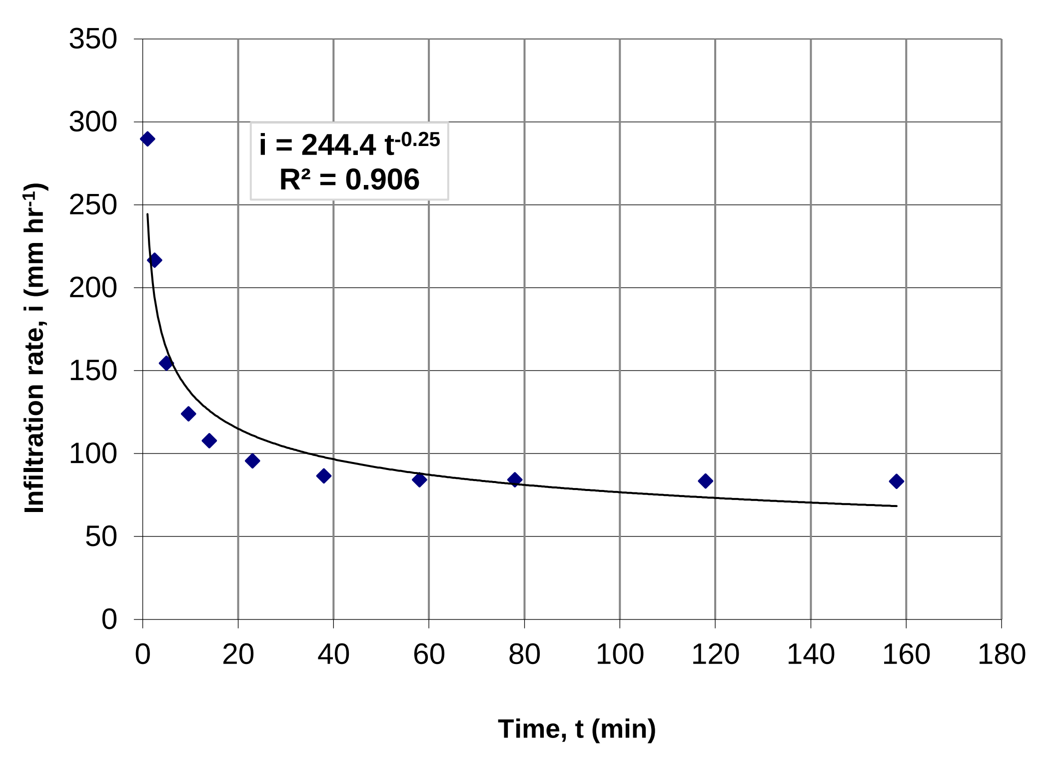

Fig (2): Soil infiltration rate with time for the studied soil.

Chemical analyses of soil

Measurements of pH of saturated paste extract were done after equilibrium for 24 hours with pH-meter model Geotechnik Hanover. The electrical conductivity of the same extract was also measured with EC-meter model D 8120 and adjusted to 25oC as described in (Van Reeuwijk, 1995). Soluble cations (Ca2+, Mg2+, K+ and Na+) and anions (Cl-, CO32- and HCO3-) were determined according to the procedure outlined by Page et al. (1982). While SO42- calculated by subtracting method according to Abu Sharar (1976). The total organic matter was determined by Walkley and Black method using wet dichromate oxidation procedure as described by Nelson and Sommers (1982). Acid neutralization method was used for determining calcium carbonate contents according to Richards as described in Rowell (1996). Cation exchange capacity was measured by using ammonium acetate according to Hesse (1972). Table (2) shows the values of these physical and chemical measurements.

Table (2): Some physical and chemical properties of Qaladiza soil.

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	

Plot dimensions and plant population

The design of split-split-plots within factorial experiment with three replicates was used. The levels of irrigation factor were implemented in the main plots and conducted with Completely Randomize Block Design (CRBD). Soil Prepared for planting in the field by making plot area (1 × 1)m, then mixing soil with agriculture media, were filled with soil, silt and organic matter in a ratio of 2:1 and organic matter at a ratio of 5 kg in all experimental units equally. The soil surface was leveled and the plant gel was added according to the specified levels, which are 150 g and 300 g and mixed well with agricultural medium.

Plowing the soil then conducted the settlement process after divided into panels with dimensions 1 × 1 m2, using blocks width 20 × 40 cm after confirmation of settlement of soil planted mixtures of seeds prose hand in panels and rates 100 gm/m2, has a coverage using a comb hand then pressed soil using roll small wooden prepared for this purpose.

The division of each plot into 9 experimental units with three replications, bringing the total to 81 experimental units measuring 1 m2, the distance between each lot is 2 meters and between experimental units 0.5 m to prevent interference between them, the surface layer of the soil was removed, the blocks were distributed with an area of 1 m2 and then a thin layer of cork was placed as an insulator in the experimental unit.

Seed cultivate

The seed that used is four types 40% Festuca arundinacea, 10% Poa pratensis, 40% Festuca arundinacea, 10% lolium perenne . The seeds were planted on 9-5-2021, where used 100 gm of the specified seeds and covered the experimental unit with Gunya to accelerate germination and prevent drought. Irrigation was carried out three times a day, and on 14-5-2021 the seeds germinated and after several days the seeds were planted the Gunya was removed and a sprinkler irrigation system was organized. At the beginning of the sixth month, the irrigation quantities were calculated according to each month.

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 .

Irrigation and Weeding

Irrigation was conducted after seeds germinate, and sprinklers used with light irrigation to prevent seeds drift. The amount of water was calculated for each plot and for each year from the beginning of the irrigation process until the beginning of the rains, through which it is possible to know the amount of water used during that period. The weeds were manually removed from the field to prevent competitive with the turf grass.

Result and discussion

Leaf area index

In the majority of water deficit studies, leaf area index is taken as the most important factors by which the biochemical processes are relied on; and it has positive linear correlation with the leaf number; that make leaf area index act like leaf number (Moosavi, 2012).

Table (3) Effect of irrigation on leaf area chlorophyll bulk density root depth and active root and plant density

Irrigation	**Leaf area cm^2**	**Bulk density g/cm^3**	**Plant density plant/m^2**	**Chlorophyll mg. ml -1 fw**	**Deep root cm**	**Effective root cm**
F(100%)	0.76 a	1.13 a	86.6 a	9.73 a	47.74 a	16.87 a
E(80%)	0.71 ab	1.02 b	75.9 b	9.72 a	44.94 b	15.64 a
S(60%)	0.63 b	1.09 a	70.4 c	9.33 b	41.34 c	15.26 b

The results of the statistical analysis of the data supported the findings of Abd el-wahed et al. (2015) and Pandey et al. (2000) that the maximum lawn LAI was obtained under well-irrigated conditions. These studies found significant differences (p 0.05) in leaf area index because to varied irrigation levels. According to Karam et al. (2003), a certain level of water stress lowered leaf area index, dry matter yield, and grain production. Reduced leaf growth rate, according to Muchow et al. (1986), resulted in less biomass production.

Water stress during plant growth is also crucial to leaf area development, potential kernel number and subsequent yield. It was also found from Table (3) that the highest leaf area index of 0.76 was obtained from full irrigation while the lowest leaf area index of 0.63 was obtained from deficit irrigation (Table 3). As well as, this table show significant difference ($p \leq 0.05$) in leaf area index among most of irrigation types.

The result in table (3) referred that plant density increase with irrigation level 100% that value was 86.6 plant/cm2 and also less value in irrigation level 60% that was 70plant/cm2, these result refer that Because of, sprinkler irrigation systems may allow for plant population densities of up to 90,000 plants per ha1. However, optimal plant population densities are influenced by soil water availability, N fertility, and other environmental conditions (Holt and Timmons, 1968).

Also According to the bulk density of soils command, the bulk density values of surface soil varied from 1.13 g/cm3 compared with 60%, which was 70.4 g/cm3. As a result This outcome was in line with the conclusions reached by Saikumar and Rao (2016) and Halder et al. (2015). Utilizing tools during crop cultivation creates favorable conditions for less bulk density and increased aeration. On the other side, less organic matter input, more compaction from tool usage, and reduced disturbances all led to an increase in the BD in the subsurface layer.

The chlorophyll content of lawn for the different irrigation (full and deficit) treatments were collected by the end of the growing season. Statistical analysis of the data showed significant difference in chlorophyll due to different irrigation levels (Table 3) that was 9.73 mg. ml -1 fw for the 100% irrigation. In the same table treatment of deficit irrigation resulted in lower chlorophyll 9.3mg.ml-1 fw for 60% irrigation level than the full irrigation treatment. This result is in agreement with the findings of other

According to Jayabalan et al. (1995; Sheela and Alexander, 1996), increased chlorophyll enzyme activity under water stress, which is harmful to plant production, may be the cause of the decrease in chlorophyll concentration during spray watering.

The data at Table 3 showed that the root length and active root of lawn under 100% irrigation level get highest value that was (16.87,47.74)cm continuously and lowest value in %60 irrigation level that get (15.64,41.34)cm continuously .

This is may be due to the shortage of water through soil profile because of the movements of irrigation water by gravity. At horizontal distance 15-20 cm, it decreased to 0.63 cm. The same results were obtained by Steel and Summerfield (1985) who found that cowpea had a rapid root growth to gain available soil water in arid and semiarid regions.

Effect of Cycoccel on leaf area chlorophyll bulk density root depth and active root and plant density.

The results in table (4) demonstrated that the cycocel hormone's influence on application time was considerable at 100ppm and 200ppm level, respectively. The mean comparison result showed that the treatment with hormone foliar spray had the greatest rate of leaf area at 0.82 cm2, and the treatment without hormone foliar spray had the lowest rate at 0.54 cm2. In comparison to the control, chlormequat chloride increased the leaf area . these result improve that (2-chloroethyl) trimethylammonium chloride's impact on growth was investigated. At 0, 100, and 200 ppm, Cycocel was sprayed three times. Cycocel lowered the height while raising the leaf area. 100ppm increased leaf area while using Cycocel spray. The negative effects were stronger at the greatest dose of 100 ppm. Aside from lowering the height, Cycocel 100ppm level also results in improved plant density and leaf area.. The CCC 100 ppm concentration caused the greatest loss in leaf area (0.82 cm2), followed by the CCC 200 ppm concentration (0.73 cm2).

Growth retardant treatment may have reduced the size and structure of cells, which may have resulted in a reduction in leaf area. The results of this study agree with prior publications by Khan and Tewari (2003), Kavitha (2001), and others.

Also, effect of CCC foliar spraying on the bulk density. The results in Table (4) indicate that spraying 100ppm has a significant effect on the bulk density that was 1.094g cm-3 compared to the control treatment, which was 1.05g cm-3 these result agree with that

Cycocel considerably decreased transpiration per seedling and the transpiration growth ratio, implying enhanced water use efficiency.

Table (4) Effect of Cycoccel on leaf area chlorophyll bulk density root depth and active root and plant density.

Cycoccel ppm	**Leaf area cm^2**	**Bulk density gm/cm^3**	**Plant density $plant/m^2$**	**Chlorophyll mg. ml -1 fw**	**Deep root cm**	**Effective root cm**
C1(0)	0.54 c	1.056 A	76.62 b	9.51 b	43.34 b	15.24 c
C2(100)	0.82 a	1.094 A	77.77 ab	9.87 a	45.25 a	16.09 b
C3(200)	0.73 b	1.093 a	78.66 a	9.40 b	45.44 a	16.44 a

In addition to effect of CCC on plant density and chlorophyll contents the results refer to that CCC 300ppm had significant effect on plant density that was 78.66 plant/cm2 compered with control treatment that recorded 76.62 plant/ cm 2, also table (4) showed that effect of treatment 100ppm that was 9.89 mg ml-1 compared with control treatment that was 9.51g ml-1,According to Appleby et al. (1966), cycocel's ability to increase chlorophyll contents may be a result of smaller cells with thicker cytoplasm. According to early reports on soybean (Bora and Sarma, 2004).

As for the roots length and active roots, the results of the experiment were as follows: Spraying with Cycosel at the level 100ppm and 200ppm had a significant effect that was (45.25 and 45.44) cm consequently compared with the control treatment, and for active root there was significant difference between the treatment the result was 16.44cm for 200ppm compared to the control treatment, the root length and active root grew with each treatment. According to Nazarudin (2012), applying CCC to the roots of Hibiscus rosa sinensis causes a rise in root length. following growth inhibitor treatment may be attributable to their synergistic action with surface auxin, which restricts root development, root system, and eventually restricted carbohydrate synthesis (Blanchard et al., 2008).

Recommendation

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

1. Based on the findings of this study, it is advised to utilize cycocel leds at a height concentration of 200 ppm to get the best outcomes of the most investigated.

2. For the purpose of mowing turfgrass, it is preferable to often spray Cycoccel on the grass to and reducing maintenance and financial sustainability.

3. To achieve the best outcome of the most researched, use irrigation level 100%.

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