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## ORGANIC FERTILIZER LIBRO AND GROWTH RETARDANT ROLE IN PHENOTYPIC AND BIOCHEMICAL TRAITS OF BERMUDA GRASS (*CYNODON DACTYLON* L.)

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### SUMMARY

The prevailing study aimed to determine the effects of organic fertilizer Libro with four concentrations (0, 1, 2, and 3 ml L<sup>-1</sup>) and the growth retardant Cultar with three concentrations (0, 0.03, and 0.05 mg L<sup>-1</sup>) on Bermuda grass (*Cynodon dactylon* L.) in a randomized complete block design (RCBD), carried out in 2022 at the University of Anbar, Iraq. The results revealed that the treatment of plants with organic fertilizer Libro at a concentration of 3 ml L<sup>-1</sup> led to a significant increase in most of the vegetative growth characteristics represented by the plant density rate, nitrogen, phosphorus, color degree, and the degree of trampling tolerance 2.500, respectively. The treatment with a growth retardant represented by Cultar reduced cutting times to 2.000.

**Keywords:** Bermuda grass (*Cynodon dactylon* L.), organic fertilizer, Cultar, Libro, biochemical traits

**Key findings:** The results showed that organic fertilizer Libro at a concentration of 3 ml L<sup>-1</sup> led to a significant increase in most vegetative growth characteristics, viz., plant density rate, nitrogen, phosphorus, color degree, and the trampling tolerance degree of Bermuda grass. The growth retardant Cultar reduced the number of cutting times.

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### INTRODUCTION

Green grass areas are necessary for the way of life of humans due to their beneficial nature. The global interest in expanding the cultivation of green grass areas includes obtaining a safe, clean, and impressive environment from an aesthetic and healthful point of view because it

has immense value in the present era and in the future in several aspects. In particular, green grass areas provide protection in sports stadiums as a cushion to protect players and reduce their injuries, as well as in children's parks, public parks, hospitals, health centers, and various educational facilities (Behe *et al.*, 2005; Jumaah *et al.*, 2021).

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Bermuda grass (*Cynodon dactylon* L.) belongs to the family Gramineae. It is a creeping perennial plant reproduced by stitches (rhizomes) and seeds in spring and autumn. Among its characteristics, it tolerates walking and trampling and is lenient of thirst (Pai and Desai, 2018). The mowing process of green spaces has become one of the environmental stresses that cause massive damage to vegetation, which reduces the green landscape in home gardens, sports stadiums, and children's playgrounds. Those in charge of serving the rapidly growing green spaces suffer from exerting efforts and spending vast sums of money as a result of frequent mowing operations. The world has recently turned to using organic fertilizers because of the random and unbalanced use of chemical fertilizers, such as applying urea with chemical pesticides. It, in turn, led to a significant deterioration in the favorable soil for agriculture, making organic fertilizers appear as environmentally friendly because of their great potential in providing all kinds of nutrients to plants.

Organic matter improves plant growth by preserving soil moisture, reducing salinity, and increasing soil fertility by activating numerous microorganisms. Humic acid is the chief activity in the synthesis of organic matter and effectively increases plant growth at low concentrations. The indirect effect on the vital processes that take place in the plant, such as, increasing the absorption of nutrients, photosynthesis, respiration, and protein-building processes, enhances the content of plant cells from green matter (chlorophyll) and the accumulation of carbohydrates (Ferrara and Brunetti, 2010; Ahmed *et al.*, 2020; Hamad *et al.*, 2023).

Cultar is a compound that has several names, including PP333 and Paclobutrazol. These are different chemical groups and have a common physiological effect as a growth inhibitor that works to reduce stem growth. As a result, plants treated with these impediments appear normal, but their stems are short. Cultar works to inhibit the biosynthesis of gibberellin (inhibit GA biosynthesis) in the plant by hindering the action of the enzyme kaurene oxidase, as well as its role in shortening the internodes of weeds, thus

reducing the need for frequent mowing operations (Diehl *et al.*, 2021). Chlorophyll produces morphological changes in leaves, such as smaller stomata openings and increased leaf thickness, and by increasing the density of roots and the number of root hairs, the rhizome will be more efficient in absorbing water and resisting stress conditions (Diehl *et al.*, 2022). The study aimed to determine the role of organic fertilizer Libro and Cultar in improving the Bermuda grass (*Cynodon dactylon*) vegetative, chemical, and phenotypic traits.

## MATERIALS AND METHODS

The experiment commenced in the fields of the Department of Horticulture and Landscaping, College of Agriculture, University of Anbar, from February 1 until October 1, 2022, to study the effect of different levels of organic fertilizer Libro and Cultar and their interaction on the growth characteristics and completeness of the seedlings. The field preparations for implementing the research began by removing the old soil with a depth of 20 cm and replacing it with the ground transferred from the research station of the College of Agriculture, University of Anbar, Al-Buaita area, in square basins of blocks with dimensions of 1 m × 1 m and a height of 20 cm. The distance between the treatments is 20 cm, with one layer of transparent polyethylene spread for each treatment with their basins perforated with 10 holes for removing excess water from the plants.

Planting the fennel seeds had dimensions of 10 cm × 10 cm, with the distance between one piece and another also at 10 cm × 10 cm. A factorial experiment using the randomized complete block design with two factors comprised the transactions distributed randomly in three sectors, each sector containing 12 treatments. The treatment was in one board containing the total experimental units of 36. The first factor included initial spraying of the shoots with a foliar spray with four levels of the Libro organic fertilizer (0, 1, 2, and 3 ml L<sup>-1</sup>). The second factor included three growth retardants (clusters) used, which

are 0, 0.03, and 0.05 gm<sup>2</sup>, dissolving each concentration with 5 ml of ethyl alcohol, bringing the volume to one liter. Spraying it as a foliar spray on the vegetative system followed the spraying date with organic fertilizer 45 days after planting the thyme cuttings upon completion of the crosslinking. After a week of treating the plants with thyme, the plants received spraying with Cultar, with the transactions sprayed twice.

### Statistical analysis

Analysis of the results used the GenStat program, with the averages compared using the least significant difference (LSD) with a probability of 5%. The RCBD used had three sectors containing 12 treatments per sector, with one trial in one square meter.

Counting the plants manually after uprooting the plants from the designated area at the end of the experiment was according to the average plant density per treatment with an area of 100 cm<sup>-2</sup>. The percentage of nitrogen in shoots (%) followed the method of Jackson (1958) and Jones and Steyn (1973). The percentage of phosphorus in shoots (%) employed the method of Olsen and Sommers (1982). Degree of color acceptability utilized the technique of Wild and Voigt (1977). The degree of trampling resistance of ethyl applied the approach by Azimi *et al.* (2014).

## RESULTS AND DISCUSSION

### Average plant density (plants 100 cm<sup>-2</sup>)

Table 1 indicated significant differences in the average plant density, with the organic fertilizer treatment characterized by a concentration of 3 ml L<sup>-1</sup>, denoted by the symbol F3. It amounted to 43,556 plants of 100 cm<sup>-2</sup>, which did not differ significantly from the treatment F2, while the comparison treatment had lesser plants at 37,000 plants 100 cm<sup>-2</sup>. Regarding the effect of the growth retardant represented by Cultar, the treatment P2 with a concentration of 0.05 gm<sup>2</sup> was

significantly superior over the rest of the treatments in the average plant density, amounting to 43,083 plants 100 cm<sup>-2</sup>, and the average plant density decreased in the control treatment at 39,333 plants 100 cm<sup>-2</sup>.

The two-way interaction between organic fertilizer and Cultar showed a significant and clear superiority in the average plant density, as the F3P2 treatment increased significantly and amounted to 47,333 plants of 100 cm<sup>-2</sup>; however, the treatment F0P0 recorded a definite decrease in the average plant density to 35,667 plants of 100 cm<sup>-2</sup>. Cultar works to inhibit the biosynthesis of gibberellin (inhibit GA biosynthesis) in the plant by hindering the action of the enzyme kaurene oxidase (Diehl *et al.*, 2021; Baidalina *et al.*, 2023).

### Percentage of nitrogen in the shoot system (%)

The statistical results in Table 2 confirmed the existence of notable differences in the percentage of nitrogen in the shoot system. In the organic fertilizer treatments, the proportion of nitrogen increased significantly when the concentration was 3 ml L<sup>-1</sup> and recorded 2.910%. This percentage decreased in the comparison treatment, which amounted to 1.549%. Concerning the Cultar treatments, P2 and P1 treatments were significantly superior to the control treatment in the percentage of nitrogen, reaching 2.125% and 2.098%, respectively.

The two-way interaction treatments revealed substantial differences in the percentage of nitrogen for the shoot's group. The two treatments, F3P2 and F3P1, were significantly distinct from the rest doses in the shoots' percentage of nitrogen, amounting to 2.993% and 2.970%, with the fraction decreasing for the treatment F0P0 at 1.377%. In significant deterioration in the favorable soil for agriculture, making organic fertilizers appear as environmentally friendly because of their great potential in providing all kinds of nutrients to plants (Hamad *et al.*, 2023).

**Table 1.** Effect of organic fertilizer Libro and Cultar on plant density (plant 100 cm<sup>-2</sup>) of Bermuda grass.

Fertilizer Libro	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	F average
F <sub>0</sub>	35.667	37.333	38.000	37.000
F <sub>1</sub>	40.667	42.333	43.333	42.111
F <sub>2</sub>	41.333	43.000	43.667	42.667
F <sub>3</sub>	39.667	43.667	47.333	43.556
P average	39.333	41.583	43.083	
LSD F		1.762		
LSD P		1.526		0.05
LSD F*P		N.S		

**Table 2.** Effect of organic fertilizer Libro and Cultar on the percentage of Nitrogen in shoots (%) of Bermuda grass.

Fertilizer Libro	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	F average
F <sub>0</sub>	1.377	1.613	1.657	1.549
F <sub>1</sub>	1.773	1.833	1.860	1.822
F <sub>2</sub>	1.903	1.977	1.990	1.957
F <sub>3</sub>	2.767	2.970	2.993	2.910
P average	1.955	2.098	2.125	
LSD F		0.054		
LSD P		0.047		0.05
LSD F*P		0.094		

### Percentage of phosphorus in the shoot system (%)

The outcomes of the statistical analysis in Table 3 indicated noteworthy variations when treated with organic fertilizer sprayed on the shoots. The treatment with organic fertilizer (F3) at a concentration of 3 ml L<sup>-1</sup> excelled in the percentage of phosphorus, reaching 0.393%, while the comparison treatment was 0.230%. As for the Cultar treatments, P2 was significantly superior with the concentration of 0.05 gm<sup>2</sup> in the percentage of phosphorus, which reached 0.322%, and the percent phosphorus decreased in the control treatment amounting to 0.277%.

About the bilateral overlap between the study treatments, the F3P2 treatment exhibited superiority in the percent phosphorus in the vegetative total, amounting to 0.457%, with the comparison treatment recording the lowest percentage of phosphorus, amounting to 0.217%. The vital processes increase the absorption of nutrients, photosynthesis,

respiration, and protein-building processes, enhances the content of plant cells from green matter (chlorophyll) and the accumulation of carbohydrates (Ahmed *et al.*, 2020).

### Color acceptability

After statistical analysis, the results of Table 4 achieved a significant increase in the degree of color acceptability in the organic fertilization treatments Libro. The treatment with a concentration of 3 ml L<sup>-1</sup> had a remarkable superiority, recording 7.663, but the degree of color decreased in the comparison treatment and recorded 3.222. The results in the table showed an increase in the degree of color when treated with a growth retardant (Cultar) at a concentration of 0.03 gm<sup>2</sup> and amounted to 6.667; however, the degree of color decreased when treated with the control, which amounted to 4.833. The results did not indicate significant differences in the binary interference.

**Table 3.** Effect of organic fertilizer Libro and Cultar on the percentage of Phosphorus (%) of Bermuda grass.

Fertilizer Libro	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	F average
F <sub>0</sub>	0.217	0.233	0.240	0.230
F <sub>1</sub>	0.253	0.273	0.283	0.270
F <sub>2</sub>	0.280	0.280	0.307	0.289
F <sub>3</sub>	0.357	0.367	0.457	0.393
P average	0.277	0.288	0.322	
LSD F		0.008		
LSD P		0.007		0.05
LSD F*P		0.014		

**Table 4.** Effect of organic fertilizer Libro and Cultar on the degree of color acceptability in Bermuda grass.

Fertilizer Libro	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	F average
F <sub>0</sub>	3.000	3.667	3.000	3.222
F <sub>1</sub>	5.000	7.000	6.333	6.111
F <sub>2</sub>	5.000	7.000	6.333	6.111
F <sub>3</sub>	6.333	9.000	7.667	7.667
P average	4.833	6.667	5.833	
LSD F		0.755		
LSD P		0.654		0.05
LSD F*P		N.S		

**Table 5.** Effect of organic fertilizer Libro and Cultar on trampling resistance in Bermuda grass.

Fertilizer Libro	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	F average
F <sub>0</sub>	1.000	1.333	1.333	1.222
F <sub>1</sub>	1.667	2.000	1.667	1.778
F <sub>2</sub>	1.667	2.667	2.333	2.222
F <sub>3</sub>	3.000	4.000	3.333	3.444
P average	1.833	2.500	2.167	
LSD F		0.474		
LSD P		0.410		0.05
LSD F*P		N.S		

### The degree of resistance to trampling

The statistical analysis results (Table 5) showed a significant increase in the plant's resistance to trampling. It was evident that the plant's resistance to trampling increased when treated with organic fertilizer F<sub>3</sub> at a concentration of 3 ml L<sup>-1</sup> and reached 3.444, while the plant's resistance to trampling decreased when treated with control, amounting to 1.222. As for the Cultar treatment, the two treatments, P<sub>1</sub> and P<sub>2</sub>,

showed a significant increase in plant resistance to trampling, reaching 2.500 and 2.167, respectively, but decreased in the comparison treatment and amounted to 1.833. Chlorophyll produces morphological changes in leaves, such as smaller stomata openings and increased leaf thickness, and by increasing the density of roots and the number of root hairs, the rhizome will be more efficient in absorbing water and resisting stress conditions (Diehl *et al.*, 2022).

**Table 6.** The effect of organic fertilizer Libro and Cultar on the rate of cutting times in Bermuda grass.

Fertilizer Libro	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	F average
F <sub>0</sub>	3.667	2.667	2.337	2.890
F <sub>1</sub>	3.667	2.333	2.333	2.777
F <sub>2</sub>	5.000	2.667	2.000	3.222
F <sub>3</sub>	7.000	3.000	1.333	3.777
P average	4.833	2.666	2.000	
LSD F		0.710		
LSD P		0.615		0.05
LSD F*P		N.S		

**The average number of shearing times for the stubble (Cut rate)**

The findings of Table 6 indicated significant differences in the number of shearing times, as the rate decreased when spraying with F<sub>0</sub> and F<sub>1</sub>, which are 0 and 1 ml L<sup>-1</sup>, amounting to 2.890 and 2.777, respectively. The shearing rate increased when treated with F<sub>3</sub> reaching 3.777. In the same table, the shearing rates of thyme decreased when treated with the growth retardant, Cultar, at a concentration of 0.05 gm<sup>2</sup> showing a value of 2.000, with the control treatment at 4.833. The interaction between the treatments did not show any significant differences in the number of shearing times. Among Bermuda grass plant characteristics, it tolerates walking and trampling and is lenient of thirst (Pai and Desai, 2018).

**CONCLUSIONS**

The treatment of Bermuda grass plants with organic fertilizer Libro at a concentration of 3 ml L<sup>-1</sup> led to a significant increase in most of the vegetative growth characteristics represented by the plant density rate, nitrogen, phosphorus, color degree, and trampling tolerance degree. The treatment with a growth retardant represented by Cultar reduced the number of cutting times.

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