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YIELD AND GERMINATION OF SEED OF CENCHRUS CILIARIS CV ZARAGOZA 115 IN RESPONSE TO PHYTOHORMONES IN NORTH OF COAHUILA, MEXICO

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Abstract: The objective of the study was to evaluate the germination and yield of buffel grass seed (*Cenchrus cilaris* cv Zaragoza 115) in response to the effect of phytohormones at different doses under irrigation in the north of Coahuila. The experiment was carried out in the period from March to July 2022, in a meadow of buffel grass var. Zaragoza 115 established in 1997, at the Zaragoza Experimental Site. Zaragoza, Coahuila. Mexico. Four phytohormones were evaluated: T1: Auxins, T2: Gibberellins, T3: T1+T2 and T4: Auxins with macro and micro nutrients) and four doses per phytohormone, including the zero dose as a control (0, 15, 30 and 45 ppm A.I. ha-1), distributed in a randomized block design in a divided plot arrangement, with four repetitions. The following were evaluated: raw seed yield (RSC ha-1), number of panicles (NP ha-1), percentage of detached seed (SD), percentage of germinated seed (SG) and the cost/benefit ratio. The use of phytohormones increased NP and RSC ($p>0.05$), where the highest values (1,785,000 panicles ha-1 and 180.55 kg raw seed ha-1, respectively) occurred with the commercial auxin FolyverÒ at 15 ppm of A.I. ha-1. The increase in CSR of Folyver® -15 compared to that of Folyver®- 0, was 30.55 % (55.17 kg ha-1). In SG, the highest value (24.36) was achieved with Radix®+Biogib® at 15 ppm I.A ha-1, higher and equal ($P<0.05$) to Radix® at 0 ppm, at 4.31%. In cost/benefit, Folyver® - 15 auxin, with an increase of 55.17 kg of raw seed ha-1 and with respect to the control, reported a benefit of $19.18:1. It is concluded that the highest yield of panicles, raw seed and benefit was achieved when applying the commercial phytohormones Folyver® at 15 ppm I.A ha-1. in buffel pastures Z115 with years of establishment.

Keywords: Buffel Z115, phytohormones, yield, germination, seed.

INTRODUCTION

Forage production and the productive capacity of beef cattle in the rangelands of northern Mexico have decreased by 70% in the last 50 years (INIFAP, 2008; SEMARNAP, 2015). The degradation of this resource is faced through animal load adjustment strategies and implementation of a grazing scheme and rehabilitation with native and introduced grasses, where buffel grass (Cenchrus ciliaris (L.), variety T-4464 occupies around of 95% of the established surface, due to its greater seed production, productive potential and drought tolerance (Saldivar, 1991); however, it is imported, has a high economic cost (Palma et al., 2000) and high susceptibility to leaf blight caused by the Magnaporte grisea fungus (Pyricularia grisea), which reduces its yield (Díaz et al., 2006). In this situation, the use of varieties adapted to local areas with potential for the establishment of grass is recommended. interest (Terrazas, 2013, Volaire, 2018; Rajora et al., 2020). In Coahuila there is a potential of 10 million hectares for rehabilitation with buffel and with a potential demand of 50 thousand tons of seed (Martínez, 2000). Currently, there is the Zaragoza 115 (Z115) variety, released by INIFAP in Zaragoza, Coahuila, Mexico. Tall variety, with good productive behavior, good nutritional value, resistant to cold, drought (Osuna, 1986) and leaf blight (Díaz et al., 2006); However, its use has been limited by low seed production and availability (Hernández et al., 2004; Enzo et al., 2022), it presents poor flowering synchronization and rapid seed abscission, which affect yield and production costs (Hernández et al., 2004). The problem of low seed yields in buffel has been addressed through genetic improvement studies (Beltrán et al., 2008; Terrazas, 2013; Enzo et al., 2022; Gómez et al., 2022) and agronomic practices such as levels of fertilization, spacing between furrows and cutting height, (Kizima et al, 2014a), and very little has been investigated on the use of phytohormones in pastures, under which increases in seed yield of 20 to 236% are reported (Espinoza and Ortegón, 1993; Eguiarte and González, 2002; Joaquín et al, 2007). Therefore, the objective of the study was to evaluate the germination and yield of buffel grass seed (Cenchrus cilaris cv Zaragoza 115) in response to the effect of phytohormones at different doses under irrigation in the north of Coahuila.

MATERIALS AND METHOD

The study was carried out at the Zaragoza-INIFAP Experimental Site, located in Zaragoza, Coahuila, at 28º 59790 north latitude and 100º 90778 west longitude at 350 meters above sea level; town with a Bs0xh' climate (dry semi-warm) with rain in summer and little throughout the year. With average annual temperature of 21. 4º C, average annual precipitation of 375 mm with bimodal distribution. The soil of the study area is characterized by having a clay loam texture, apparent density of 1.08 g/cm3, moderate organic matter content (1.83%) and no salinity problems; very poor in nitrogen (N), medium in phosphorus (P) and potassium (K), low to medium content in minor elements; limited in their availability due to the alkaline pH (8.39) and very high content of total carbonates (68.1%) (Fertilab, 2022). 900 m2 of buffel grass meadow cv Zaragoza 115, established in 1997, were used. 64 experimental plots (EP) of 5 m2 (2.5 m x 2.0 m) with a useful plot (PU) of 2 m2 (1.0 m x 2.0 m) were drawn. under a randomized block experimental design with a split plot arrangement and four repetitions. Four phytohormone treatments were evaluated: T1: Auxins using the commercial product (T1: Radix 10000®), T2; Gibberellins (Biogib 10 PS®), T3: Combination of T2+T3 and T4: Auxin with macro and micronutrients (Folyver®), with four concentration levels

including the zero control (0, 15, 30 and 45 ppm A.I. ha-1). At the beginning, the grass was made uniform by cutting it 05 cm from the ground. It was fertilized under the NPK formula (100-50-50) and adjusted based on the results of the soil analysis. In total, four irrigations were given, with a frequency of 13 days and sheets of water per irrigation of 13 cm. The treatments were applied foliarly at 50% anthesis of the plants, early in the morning (7:00 am). The variables evaluated were the number of panicles (NP ha-1), raw seed yield (RSC kg ha-1), percentage of germinated seed (SG) and the cost/benefit ratio. The NP was determined directly by manually cutting with pruning shears all the panicles present (complete panicles (PC) and incomplete panicles (PI)), with seeds at harvest point in each experimental unit on three occasions during the period from 08 to 2008. June 18, 2022. A sample of five PCs and one of five IPs were randomly separated from each treatment. After one month, the seed was separated from each respective sample and the weight was recorded on a digital scale with a precision of 0.001g; With the weight of these and the NP, RSC was determined. The SG was performed in Petri dishes provided with cotton pads and placed on a work table under ambient conditions (average temperatures of 39± 3 ºC) for a period of 28 days and with counts every 7 days. In each Petri dish, a sample of 100 florets from seven months of storage, taken at random from each treatment, was placed. To estimate the cost/benefit relationship, only the expenses and income from the application of the phytohormone treatment were recorded and only the outstanding treatment was analyzed with respect to the control and the income per seed, only for the increase with respect to the control. The data obtained, except for the cost/benefit ratio, were analyzed by analysis of variance and comparison tests of means (DMS<0.05), the SAS statistical program, version 9.4, was used. (SAS, 2004).

RESULTS AND DISCUSSION

The number of panicles (NO) is shown in Table 1, where it is observed that the highest number of panicles (P<0.05) was obtained in the treatment T_{14} (Folyver Ò-15) with a total of 1,785.0 panicles ha^{-1}, higher and equal to T_{16} and T13 (Folyver® - 0) in 7.01 and 21.07% equivalent in 125,200 and 376,200 panicles ha-1, and higher than the rest, where T12 produced the least amount. The best response of T14 and T_{16} was possibly due to their composition containing, in addition to auxin, macro and micronutrients that correct deficiencies in the study soil due to their low availability due to high Ph (8.39) and very high carbonates. (68.1%), indicated in the results of the soil analysis (Fertilab, 2022).

The NP obtained in the present work with T14 is lower than those reported by Eguiárte and González (2002), who obtained an average of 2,124 panicles (Thousands/ ha-1) with a range of 1,976.6 to 2,344.4 with the application of the floral inducer AGR® working for three years in Jalisco, with floral inducers in a newly established meadow with buffel cv Biloela. The difference may be due to the difference in age at the time of the study, being 25 years old in the Z115 buffel pasture and that the NP corresponds to one of two productive cycles in the year.

As in the NP variable, the RSC was affected (P<0.05) by the treatments (Table 1), where the highest yield was recorded by T14 (Folyver® - 15) with 180.55 kg ha-1, greater than and equal to T16 (Folyver® - 45) and T13 (Folyver®- 0), with increases of 3.58 and 30.55 % (6.47 and 55.17 kg ha-1), respectively.

The yields obtained were higher than the 60 kg ha-1 reported by Cuellar and Hernández (1989) in Z115 with three plots in Zaragoza, Coahuila, with the 100-50-50 fertilization

TREATMENT (Phytohormone-ppm/ha^{-1})	NP (Thousands ha^{-1})	RSC (kg ha^{-1})	SG (%)
T_{14}: FolyverÒ-15	1,785.0 ^{a}	180.55 ^{a}	19.13 ^{ba}
T_{16}: FolyverÒ-45	1,659.9 ^{ba}	174.08 ^{ba}	14.37 ^{b}
T_{13}: FolyverÒ-0	1,408.8 ^{bac}	125.38 ^{bac}	-
T_{15}: FlyverÒ-30	1,264.5 ^{bdac}	124.15 ^{bac}	22.36 ^{ba}
T_{1}:RadixÒ-0	1,228.8 ^{bdc}	102.23 ^{bac}	20.05 ^{ba}
T_{9}:RadixÒ+BiogibÒ-0	1,152.5 ^{bdc}	123.35 ^{bac}	-
T_{8}:BiogibÒ-45	1,126.3 ^{bdc}	92.33^{c}	20.28 ^{ba}
T_{5}:BiogibbÒ-0	1,100.0 ^{dc}	91.70 ^{c}	-
T_{4}:RadixÒ-45	1,090.0 ^{dc}	86.17 ^{c}	19.36 ^{ba}
T_{3}:RadixÒ-30	1,078.8 ^{dc}	68.60 ^{c}	15.93 ^{ba}
T_{10}: RadixÒ+BiogibÒ-15	1,076.3 ^{dc}	108.50 ^{bac}	24,36 ^{a}
T_{7}:BiogibÒ-30	1,048.8 ^{dc}	81.28 ^{c}	20.74 ^{ba}
T_{2}:RadixÒ-15	1,028.8 ^{dc}	94.73 ^{bc}	20.40 ^{ba}
T_{11}: RadixÒ+BiogibÒ-30	1,026.3 ^{dc}	89.50 ^{c}	15.37 ^{ba}
T_{6}:BiogibÒ-15	942.5 ^{dc}	83.25 ^{c}	16.17 ^{b}
T_{12}: RadixÒ+BiogibÒ-45	847.5 ^{d}	98.95 ^{bc}	19.44 ^{ba}
DMS	553.5	81.48	9.26

DMS: Minimum significant difference. For each column, values with different literals are statistically different (P<0.05). **NP**: Number of panicles; CSR: Raw seed yield; SG; Germinated seed.

Table 1. Average behavior of panicle and seed variables of buffel Z115 under the effect of phytohormones at the Zaragoza-CIRNE-INIFAP Experimental Site, 2023.

CONCEPT		U.M	P.U ($)	C.E (Liter)	C.U ($)	C.I.B ($)
A	**Supplies:**					
	T_{14}: FolyverÒ-15 ppm	Liter	100.00	0.500	0.100	50.00
	pHase-1Ò (Acidificante)	Liter	250.00	0.250	0.250	62.50
	BionexÒ (Adherente)	Liter	165.00	0.500	0.165	82.50
B	**Labour**	Wage	350.00	1.0	350.00	350.00
C	**Expenses:** Technological Cost	$				545.00
D*	**Entry:** (55 kg x$200.00)	$			200.00	11,000.00
E	**Relationship:** B/C	$				19.18:1

U.M: Unit of measurement; P.U; Unit price; C.E: Quantity used; C.U: Unit cost; C.I.B: Cost, Income, Benefit. *: Increase in seed in the best treatment in relation to the control x regional sales price. Note: 1 U.S. Dollar = $20.72 MXN. (Consulted; July 2022).

Table 2. Costs/benefit per hectare of outstanding treatment. Zaragoza CIRNE-INIFAP Experimental Site, 2023.

formula. As well as those obtained by Lara (1989), who reports for Z115 in Zaragoza, Coahuila and under irrigated conditions, average yields of 43 and 35 kg ha-1 with two pinches; lower than 89 kg/ha, reported by Martínez (1996) and these lower than that reported by Briones (1991) who obtained 249 kg ha-1, but in three harvests in the year.

In SG, the highest percentage (24.36) was obtained with T10 and the lowest percentage (14.37) with T16. (Table 1). In this range there are 10 treatments with the same difference ($P<0.05$), in which T14 can be seen that produced the highest CSR value and T1 (Radix®-0), both surpassed ($P<0.05$) by T10 at 5.23 and 4.31%, respectively. It also exceeded by 7.36% the maximum value (17%) reported by Sénz et al (2015) in buffel in Aldama, Chihuahua. But lower than the 60% germination reported by Cuellar and Hernández (2007). The difference with respect to the latter could be due to the rest time of the seed prior to the test since it was not indicated; In this regard, Eguiarte and González (2002) mention high germination in seeds of *Cenchrus cliairs L cv Biloela* with rest periods of 18 to 20 months. The germination obtained in the present study could also be due to the age of the meadow and the density of plants, since Kizima et al (2013) observed lower seed germination in four-year-old meadows in relation to those of recent establishment, by carrying out seed quality sampling on three farms. As well as, (Kizima et al, 2014a) to the smaller spacing between plants, finding in a study on the establishment of meadows for seed production purposes, that the spacing between rows of 25 cm produced seed of lower quality than the spacing between rows of 75 cm.

Finally, the cost and benefit of the technology with the best CSR is shown in Table 2. The application of T14, with expenses of $545.00 and income of $11,000.00, generated a B/C ratio of 19.18:1. Benefit higher than the return rate obtained by Medina and Osuna (1989) of 2.1 and 2.0 in buffel Z115 with yields of 56.8 and 75.8 kg ha^{-1} of raw seed in two harvests with fertilization doses 150-100-00 and 250 -100-00 and, to the benefit obtained by Kizima et al (2014b) of 0.59 pesos per unit invested in buffel cv Biloela, with yields of 78.6 kg ha-1 and 13.2 ton ha-1 of dry forage, with the fertilization dose 60 kg N and 30 kg P ha-1, in the wet season with irrigation in the first year of establishment, due to the costs of irrigation and materials and inputs for the establishment.

CONCLUSIONS

The foliar application of Folyver at a dose of 15 ppm of I.A/ha-1 to Buffel Z115 grass in the productive cycle from April to June, favored the highest raw seed yield (180 kg ha-1) with an increase of 30.55% (55.17 kg ha-1), in relation to T13 (Folyver®-0); with 19.4% germination and a benefit/cost ratio of 19.18:1.

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