

EFFECT OF GIBBERELIC ACID ON SEED GERMINATION PERCENTAGE AND GROWTH PERFORMANCE OF TWO CASSIA SPECIES

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ABSTRACT: The experiment was conducted in the plastic-house of the Department of Horticulture and Landscape at the College of Agriculture and Forestry, University of Mosul, Iraq during the period of 10/4/2018 and 31/1/2019 on two species of Cassia. Seeds were planted each seed depth twice the length of the seed in a plastic bowl (8 cm height, 6 cm diameter) full with a medium consisting of perlite, peat moss and sand with 1:1:1 (v/v/v) ratio. The developing seedling were then transferred to plastic pots with a diameter of 15 cm and a height of 12 cm in the same agricultural medium and transplanted into the plastic house after germination. The experiment was carried out by using two factors in split-plot design within randomized complete block design (RCBD). The first factor was two species of Cassia: *Cassia surattensis* and *Cassia siamea*, while the second factor was soaking seeds in gibberellic acid at three levels of (0, 500 and 1000 mg L⁻¹) for 48 hrs. The results showed that *C. surattensis* was superior in all seedling traits except for the leaf area, which was higher than *C. siamea*. Gibberellic acid had an important role in improving seedling properties and when used at (1000 mg L⁻¹) on *C. siamea* the seedling height and leaf area were increased. There were no significant differences in both species of Cassia in some traits including seedling height. *C. surattensis* was characterized by its ability to flower in November after the appearance of flower buds at the beginning of the same month. Species differed in their tolerance to environmental conditions *C. surattensis* survived under cold waves, however, *C. siamea* was unable to survive under the same conditions in January.

Key words: *Cassia surattensis*, *Cassia siamea*, GA₃, gibberellic acid, germination, seedling growth.

INTRODUCTION

Cassia is one of the 25 largest species in the world belonging to the Family Leguminosae and the genus *Cassia* has the most flowering species of economic importance (Sanyal, 2015). Most species of Cassia are grown on a wide scale, they are very useful as trees and suitable in non-fertile lands lacking organic matter and which have the potential to reduce soil

erosion and increase their fertility (Khan, 2013). The economic importance of species *Cassia surattensis* is due to its multiple uses, as it is used for food. The leaf is used for healing cough, sore throat, also for its landscape importance as decorative plants and shade trees or windbreaker. It is an evergreen flowering tree, medium to large in size, fast-growing, loving the direct sun and blooming heavily yellow flowers in the dry season from August to October (Viegas Jr et

al., 2004; Kumar, 2015; Sanyal, 2015 and Hanelt *et al.*, 2001). The original home of *Cassia siamea* is Southeast Asia in India and is called yellow Cassia, which gives yellow flowers. It is a medium-lasting tree with large yellow floral clusters and grow in high temperate and warm atmosphere as an ornamental tree (Parrotta and Francis, 1990 and Sanyal, 2015). *Cassia siamea* used in the formation of plant fences, windbreaks in arid lands, as green zone grown on both sides of the roads and it is important to adopt because of the speed of its growth and sustainability of greenery (Meena and Sharma, 2014; Jonsson *et al.*, 1988 and Sastry *et al.*, 2003).

The dormancy of seeds is one of the most important factors in the propagation of plants. The closure of the passage of water to seeds is the most common cause of delay in seed germination. Cassia species suffer from the dormancy resulting from preventing water from entering the thick seed cover, preventing water and oxygen from reaching inside (Karthika *et al.*, 2016). The hard casing and low germination rate are the main determinants of commercial cultivation of these species (Al-Menaie *et al.*, 2009). Several treatments have been proposed to overcome the hardness of the casing and improve the rate of germination over a relatively short period.

GA₃ is one of the most used to stimulate germination as well as stimulating seedling elongation (Hudson, 2005). Several studies have shown that the treatment of seeds with sulfuric acid resulted in a break in seed dormancy. Begum *et al.* (2013) noted that *Cassia auriculata* seeds were successfully seeded with 100 mg L⁻¹ for 3 hrs which raised from 20 to 98% as the best seedlings. Sherif and Kalabi (2017) soaked the seeds of *Pinus halepensis* in 300 mg L⁻¹ gibberellic acid which increased the proportion of germination and the height of seedlings.

This research was initiated in order to find out the effect of gibberellic acid on seed germination and growth performance of two species of Cassia.

MATERIALS AND METHODS

The experiment was conducted in the plastic-house of the Department of Horticulture and Landscape at the College of Agriculture and Forestry, University of Mosul during the period from 10/4/2018 to 31/1/2019.

Each seed was planted in a depth twice length in a plastic bowl (8 cm height, 6 cm diameter) full with a medium consisting of perlite, peat moss, and sand with 1:1:1(v/v/v) ratio. The developing seedlings were then pecked out to plastic pots with a diameter of 15 cm and a height of 12 cm in the same agricultural medium and transplanted into the plastic-house after germination.

The study was carried out as 2 × 3 factorial experiments within randomized complete block design (RCBD). The first factor was two species of Cassia: *Cassia surattensis* and *Cassia siamea* placed in the main plot, while the second factor was soaking seeds in gibberellic acid at three levels (0, 500 and 1000 mg L⁻¹) for 48 hrs placed in the subplot. The experiment consisted of 24 experimental units resulting from the interaction of the two factors with four replicates. The experimental unit contained 25 seeds. Germination percentage (%) was calculated by counting the number of natural shootings at the end of the count, 19 days for the first species, 60 days for the second species for all replicates.

The average of the four replicates was calculated by applying the following formula adopted from the International Rules for Seed Testing (International Seed Testing Association, 1996).

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

The percentage of seedling survived (%): which were able to resist seedling wilt disease, when transferred to the plastic-house covered with saran. It was calculated according to the following equation:

$$\text{Survival percentage} = \frac{\text{Number of seedlings survived}}{\text{Total number of seeds sown}} \times 100$$

Also measured by the rate of seedling day⁻¹: according to the equation cited by Heydecker (1968).

$$\text{Germination rate} = \frac{G_1}{T_1} + \dots + \frac{G_2}{T_2} + \frac{G_n}{T_n}$$

G₁, G₂,, G_n: represent germination calculated per day (n).

T₁, T₂,, T_n: time taken in days (5, 10, 15, 19 days for the first species) and (40, 45, 50, 55, 60 days for the second species).

At the end of the experiment, the following parameters were measured: seedling height (cm), leaf area (cm²), fresh and dry biomass of seedling (g) and the force of the seedling (shoot vigor index “SVI”) according to the equation: germination percentage (%) × branch length (cm).

The SAS program was used to analyze data and means of treatments were compared statistically by using Duncan’s multiple test at 5%.

RESULTS AND DISCUSSION

Data presented in Tables (1 and 2) show the effect of different gibberellic acid concentrations on germination and seedling growth parameters of two species of *Cassia*. Over all, *C. surattensis* was significant in germination percentage, survival percentage and germination rate when compared to *C. siamea*. However, *C. surattensis* on the other hand was more significant in the attributes of the strength of the branch and the biomass of dry and fresh weights. As for the effect of gibberellic acid, when increasing the concentration of gibberellic acid, a significant upsurge in germination percentage, survival percentage and germination rate were obtained. Meanwhile, the higher concentration (1000 mg L⁻¹) caused significant increases in seedling height, shoot

vigor index, biomass for fresh and dry weights when compared to the control.

Following the results of germination parameters, *C. surattensis* was observed significant in all parameters of germination compared to *C. siamea*, which ranged from 50 to 90%. In many other studies (Rocas, 2004 and Acquah *et al.*, 2015) germination ranged from 12.33-23.00% which may be due to the fact that the seeds used are stored for a long period of time or that the seeds may be stored in unsuitable conditions (Acquah *et al.*, 2015), and that the superiority of species *C. surattensis* in the survival percentage and germination rate above *C. siamea* can be attributed to the high percentage of germination (Bashi and Alkhero, 2017). Also, the results showed that the increase in the concentration of gibberellic acid caused increases in the survival percentage and the rate of germination of *C. surattensis* and the high concentration only increased in the percentage of germination. While in *C. siamea*, both concentrations of gibberellic acid were appropriate to increase the percentage of plants survival. Results of germination agreed with both Begum *et al.* (2013) when *Cassia auriculata* seeds were soaked with gibberellic acid at a concentration of 100 mg L⁻¹ for 3 hours and with Rout *et al.* (2017) when *Cassia fistula* seeds were soaked with gibberellic acid at a concentration of 760 mg L⁻¹.

As for the results of the seedling characteristics, *C. Surattensis* was superior in all seedling traits except for the leaf area. Some important things can be discussed, although the growth period of *C. siamea* was relatively low compared with *C. surattensis* due to the delay of germination, but it’s fast growing Feature gave the seedling height a similar rise boost. Another important issue is the superiority of *C. siamea* in the leaf area over *C. surattensis*. This can be due to the nature of leaves, which contain the largest number of leaflet pairs, which was positively reflected in the increase of leaf area, although there is no difference in the number

Table 1. Influence of gibberellic acid concentration on germination parameters of two *Cassia* species.

Treatments		Germination percentage (%)	Survival percentage (%)	Germination rate (seedling day ⁻¹)
Cassia species				
<i>C. surattensis</i>		4.95 a	35.11 a	50.33 a
<i>C. siamea</i>		0.64 b	19.00 a	26.44 b
Gibberellic acid conc. (mg L⁻¹)				
0		1.91 c	21.33 c	31.66 c
500		2.76 b	28.16 b	38.50 b
1000		3.72 a	31.66 a	45.00 a
Cassia species × Gibberellic acid conc. (mg L⁻¹)				
<i>C. surattensis</i>	0	3.40 c	30.00 c	43.66 b
	500	4.86 b	35.00 b	48.66 b
	1000	6.61 a	40.33 a	58.66 a
<i>C. siamea</i>	0	0.42 d	12.66 e	19.66 d
	500	0.67 d	21.33 d	28.33 c
	1000	0.84 d	23.00 d	31.33 c

Means within a column having the same letters are not significantly different according to Duncan's multiple range test.

Table 2. Influence of gibberellic acid concentration on seedling growth parameters of two *Cassia* species.

Treatments		Seedling height (cm)	Leaf area (cm ²)	Shoot vigor index	Fresh weight biomass (g)	Dry weight biomass (g)
Cassia species						
<i>C. surattensis</i>		24.73 a	681 b	849.56 a	57.16 a	11.34 a
<i>C. siamea</i>		25.15 a	1152 a	424.29 b	26.80 b	4.85 b
Gibberellic acid conc. (mg L⁻¹)						
0		24.00 b	858 a	504.97 c	44.99 a	8.72 a
500		24.32 b	860 a	635.91 b	49.00 a	8.74 a
1000		26.50 a	1032 a	769.90 a	31.66 b	6.83 b
Cassia species × Gibberellic acid conc. (mg L⁻¹)						
<i>C. surattensis</i>	0	24.47 b	832 b-d	722.35 b	65.79 a	8.72 a
	500	24.96 b	657 d	854.70 a-b	65.09 a	8.74 a
	1000	24.57 b	553 d	971.64 a	40.60 b	6.83 b
<i>C. siamea</i>	0	23.52 b	885 b-d	287.58 d	24.19 c	8.72 a
	500	23.69 b	1062 b	417.11 d	33.51 b	8.74 a
	1000	28.25 a	1511 a	568.17 c	22.71 c	6.83 b

Means within a column having the same letters are not significantly different according to Duncan's multiple range test.

of leaves. The results also showed the positive role of gibberellic acid at a high concentration in the production of excellent seedlings of *C. siamea*, which resulted in an increase in seedling height and leaf area, while low concentration was better in improving the fresh weight biomass. The high concentration of gibberellic acid was excellent to increase shoot vigor index in *C. surattensis*. This result agreed with Venkatesh *et al.* (2000), who attributed the

increase in the leaf area when the *Pongamia pinnata* seeds were soaked in gibberellic acid. The increase in seedling height could be due to its role in the process of division and elongation of cells (Auskalniene and Auskalis, 1996). Differences between the two species under study in the traits of seedlings can be interpreted on the basis of genetic differences between species. Results herewith corresponded with what those

happened by Bashi and Alkhero (2017) on Bauhinia.

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تأثير حامض الجبريليك على النسبة المئوية لانبات بذور نوعين من الكاسيا ومظاهر نموها

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أجريت التجربة في البيت البلاستيكي التابع لقسم البستنة وهندسة الحدائق في كلية الزراعة والغابات، جامعة الموصل، جمهورية العراق خلال المدة من ٢٠١٨/٤/١٠ إلى ٢٠١٩/١/٣١ على نوعين من نبات الكاسيا. نفذت التجربة باستخدام عاملين بتصميم القطاعات العشوائية الكاملة RCBD بنظام القطع المنشفة Split plot within completely randomized block design تضمن العامل الاول الانواع: *Cassia siamea* و *Cassia surattensis* والعامل الثاني النقع بحامض الجبريليك بثلاث مستويات (٠، ٥٠٠ و ١٠٠٠) ملجم لتر^{-١} لمدة ٤٨ ساعة. فأظهرت النتائج تفوق النوع *C. surattensis* في جميع صفات البادرات فيما عدا صفة مساحة الورقة التي تفوق فيها النوع *C. siamea* بينما كان للجبريلين دور مهم في تحسين صفات البادرات عند استخدامه بكلا تركيزيه ولكلا النوعين. واستخدام التركيز العالي من حامض الجبريليك (١٠٠٠ ملجم لتر^{-١}) كان له دور في تحسين صفات بادرات النوع *C. siamea* في كل من ارتفاع البادرات والمساحة الورقية. لم يكن هنالك اختلافات معنوية لكلا نوعي الكاسيا في بعض الصفات، منها ارتفاع البادرات. تميز النوع *C. surattensis* بقدرته على الازهار في شهر تشرين الثاني بعد ظهور البراعم الزهرية في بداية نفس الشهر. يمكن القول ان الانواع اختلفت في مدى تحملها للظروف البيئية اذ نجح النوع *C. surattensis* في النجاة من موجات البرد على العكس منه النوع *C. siamea* الذي لم يتمكن من النجاة تحت نفس الظروف الحاصلة في شهر كانون الثاني.