

Study of the possible allelopathic effects of *Senecio inaequidens*, c (seneçon du cap)

Keywords: *Senecio inaequidens*, Allelopathy

Introduction

Senecio inaequidens, (seneçon du cap) is a plant native to South Africa,¹ which was observed in France in 1936, after which a second source of infestation was identified in the vicinity of the tanneries of Mazamet.^{2,3} Being the fleeces of wool (toisons lainières) that transport the seeds of this plant, and it is there that since 1940, this plant began to spread throughout France, always in the vicinity of the wool industry. Likewise, this plant is currently located in other European countries such as Switzerland, Spain, Italy, Germany, Denmark, Holland.⁴ At the moment it is a weed that is in full expansion in Europe, and that can get to cover more than 90% of the infested surfaces. It is for these reasons that we intend to carry out this study, to know if one of the causes of its rapid expansion is due to exerting an exclusion pressure on other plant species, due to allelopathic effects. It is also a plant that predominates in prairie areas, and in areas not cultivated its dominance has also been observed so it is supposed to have allelopathic effects and for that reason it manages to develop more easily and cover those areas of new infestation. This is because there are many reports,⁵⁻¹¹ on the production of alkaloids, by the species of the genus *Senecio*, which cause harmful effects to the animals that consume them, so perhaps some allelopathic effects could also be expected towards other species of plants of the native flora. It is also important to note that another possible cause of its large expansion in prairie areas,^{12,13} is because livestock (cows, sheep, horses, etc.), do not eat this plant because it produces substances that are toxic to animals,^{14,15} reason why, in the prairies this plant may predominate more, since animals do not consume it and with this its expansion is faster. In order to know if this plant presents those possible allelopathic effects, the following research work is proposed; posing as objectives: To evaluate the germination of different species of botanical families of plants, using the radical exudates and maceration juices of fresh aerial parts, to know if there are allelopathic effects, that can inhibit the germination and growth of the seedlings, in the first stages of development.

Materials and methods

1st phase: reproduction of *Senecio inaequidens* plants for the production of radical exudates

To start the work on the possible allelopathic effects, plant material (cuttings) was collected on October 13.2000, which were put to root in the substrate, (neuhaus N2, content: dry matter mass of dry product=25%, organic matter =20%, pH water=6.0, resistivity = 800 ohm-cm water retention capacity=800 ml/l) where they were kept, from the sowing of the cuttings to reproduce the plants that would serve as donators of the radical exudates.^{16,17} On November 18 the sand that would serve as a substrate was placed on the trays, where the seneçon du cap plants would grow, and distilled water was added during a period of 24 hours, this water was later removed and planting started of seedlings of *Senecio du cap*, for the production of radical exudates.

Before transplanting the seedlings of *Seneçon du cap* to the trays, the roots were washed with distilled water, until all the residues of

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the substrate where they grew were removed. Later the plants were transplanted in the trays. On November 20, the seedlings were implanted in the trays, (30 days after the cuttings were planted), and from that date, they were kept only with distilled water during the following three days, to facilitate their adaptation to the new substrate.

After the first three days of the transplant, the Hoagland nutrient solution was applied to the concentration of 0.25,¹⁸ for a period of four days, with the purpose of adapting to it. After the first four days that were maintained with the Hoagland solution at the concentration of 0.25, they were already maintained during the entire time they took growth with the nutrient solution at the concentration of 0.50, until the end of the experiment, as recommended by (López & Maillet, personal communication).

From the moment of the transplant, each day 200 ml of the nutritive solution of Hoagland was added to each tray to maintain the plants, this amount of solution increased as the plants grew. Thus, upon reaching 30 days of the transplant, they were increased to 300 ml of nutrient solution daily, and after 60 days, it was again increased to 500 ml of nutrient solution per day, until 90 days, when they were finally added 800 ml of the nutritive solution per day, to maintain them.

On November 27 all the plants were pruned to obtain a similar development. And on November 30 and December 7, fungicidal treatments were given with the M45 captan product, which contains 80% mancozeb at the dose of 2gr of product/liter of water, to control rust (*Puccinia lagenophorae*), which It was presented in the plants. The trays where the plants grew, have the following measures: height 16.0 cm x 53.5 cm long and 34.5 cm wide. Planting 24 plants per tray, distributed in three rows with a separation of 10 cm, to have a population density of 130/m².

The conditions of temperature and luminosity in which the plants were kept in the greenhouse were the following: 15 light hours, distributed as follows, from 6 to 9 in the morning and from 16 to 21 hours, with temperatures of 2°C during the day and 20°C during the night. The lighting in the greenhouse was with Bartholin type bulbs 0.5J-20°<T<+40°) and high pressure sodium tubular steam lamps of the SONT Agro type, with an energy yield of 300 mW/W

2nd phase: experimentation with radical exudates

The experiments were carried out in the Laboratory of Biology and Pathology Végétales, of the Ecole Nationale Supérieure Agronomique de Montpellier, France; using seven representative species of equal number of families, and the seneçon de cup, the species are listed below: *Senecio inaequidens* D.C. (Seneçon du cap) Asteraceae; *Lycopersicum esculentum* L. cv. Saint Pierre (Tomato) Solanaceae; *Daucus carota* L. cv. From Colmar to couer rouge (Carrot) Umbelliferae; *Raphanus sativus* L. cv. Flamboyant (Radis) Cruciferae; *Hordeum vulgare* L. cv. Alpha (Barley) Gramineae/Poaceae; *Lactuca sativa* L. cv. Rouge Grenobloise (Lettuce) Compositae; *Bromus catharticus* (Brome catarthiques) Gramineae /Poaceae; *Medicago sativa* L. cv. Salernes (Luzerne) Papilionaceae.

Three experiments were carried out with radical exudates in three different phonological stages of development of the seneçon du cap (juvenile, intermediate and flowering), and the same nutrient solution of Hoagland was used as controls, with which the seneçon du cap plants were maintained. Distilled water, to observe the germination of the seeds and the growth of the hypocotyl. In each treatment, 50 seeds of each species were used to observe and evaluate the possible allelopathic effects of the seneçon du cap. In all the trials (radical exudates), the observation period for seed germination was seven days, with daily counts of the number of seeds germinating each day, at the end of which the hypocotyl was measured the seedlings. The measurement of the seedlings was carried out in the following way, from the point where the root formation begins until the beginning of the formation of the first leaf, and for the case of the barley, it was measured in the same way, from the point of formation of the roots, but the whole seedling, because of the difficulty of measuring the point where the first leaf leaves. Finally, to start all the allelopathy trials on December 12, when the seneçon du cap plants had 22 days of being transplanted to the trays, 100 ml of the nutrient solution was collected with the radical exudates of each tray for the realization of the first test. At the time of the first trial, the plants of Seneçon du cap, presented on average the following plant heights by trays: (1)27.91cm. (2)27.5cm. (3)26.08cm. and (4) 28.95cm. The first trial (juvenile phonological stage) began on December 13, 2000, concluding on the 21st of the same month. To carry out the second trial (intermediate phenological stage), 100 ml of the nutritive solution was collected on a daily basis on January 4 and 5, 2001, and the solution collected on January 4 was kept refrigerated. Together with the solution collected on January 5, 800 ml of solution were mixed to obtain the amount required for the test. It should be noted that at this time the seneçon du cap plants had 45 days of being transplanted to the trays. The third test with the radical exudates (phonological stage of flowering) was carried out from March 30, 2001, obtaining in the same way to the previous test, the amount of 800 ml of the nutrient solution with the radical exudates. By this time the plant had 130 days of being transplanted to the trays and was in the flowering stage.

It is important to note that there were some differences in the performance of the different tests, being fundamentally the following: In the case of the first test with radical exudates, circular petri dishes, 10 cm in diameterx1.1 cm high, were used, and three white filter papers of type MN40 m of 9 cm Ø were placed in the base (plates of ashless filters, white boxes) (Macherey-nagel), and on the paper the 50 seeds were placed, to which they were added on a single occasion, 8 ml of the solution of each treatment, to each Petri dish. For tests 2 and 3 with radical exudates, plastic boxes with the following dimensions were used: 12.0x18.5x15 cm in width, length and height

and as a substrate they were placed accordion type filter paper. In each germination box, 50 ml of the treatment solution (distilled water, nutrient solution or radical exudates) were added on one occasion, placing seeds of two species per box, that is, 100 seeds per box.

Experimental design

The experimental design used to implant the tests with the radical exudates and maceration juices, in the germination of seeds and the growth of hypocotyl, was a factorial arrangement of 8x3, in divided plots, placed in a completely block design. randomized, with three repetitions; where the factors were the Species (8) and Solutions (3), the main plots being the Solutions factor (distilled water, nutrient solution and radical exudates) and the Species factor, (*Senecio inaequidens* DC, *Lycopersicum esculentum* L. *Daucus carota* L., *Raphanus sativus* L., *Hordeum vulgare* L., *Lactuca sativa* L., *Bromus catharticus*, *Medicago sativa* L.), subplots.

Statistic analysis

The analysis of variance was performed, for the parameters evaluated, which were n° of germinated plants, height of the hypocotyl, germination index,⁵ the latter, to observe if there were differences between the treatments of the solutions and a acceleration or delay in germination. Finally, the hypocotyl growth of the plants was compared in the different Solutions treatments, from the tests with the radical exudates.

Results and discussion

First trial with radical exudates

As a result of the first trial (juvenile phonological stage) that was carried out as of December 13, 2000, and which was concluded on the 21st of the same month. with the radical exudates of seneçon du cap, for the variable germination of seeds, it was possible to verify according to the results of the analysis of variance (Table 1), that only statistical differences were observed for the Species factor, a result that can be considered normal, since that, as expected, there are differences in germination between different plant species (Table 2). However, no statistical differences were observed for the Solutions factor, which is where it would be interesting to observe the behavior of the germination of the different species, depending on the solutions used for germination (Table 1). It is also important to note that no statistical differences were observed for the Interaction factor (Species x Solutions), which shows that, at this phonological stage, the seneçon du cap plant has no allelopathic effect on the germination of any of the species used to evaluate these possible effects (Table 1).

Table 1 Variance analysis of seed germination with the treatment of radical exudates in the 1st. phenological stage of the plants of seneçon du cap. (1st trial)

	S.c.e.	Ddl	S. means	Test f	Prob ab
Var. total	98.97	80	1.24		
V. especie	77	8	9.70	32.43	0.0000
V. solution	1.55	2	0.77	2.59	0.0828
V.interacc	3.68	16	0.23	0.77	0.7122
V. residual	16.15	54	0.30		

When performing the analysis of variance of the measurement of the size or height of the hypocotyl, of the results obtained seven days after the first trial where the possible allelopathic effects of the

seneçon du cap are being evaluated, it was observed that there were only statistical differences for the factor Species, that is to say, as a consequence of the differences between the species, the growth of the hypocotyl is greater in some species than in others, but not as results of the effect of the radical exudates of the seneçon du cap; This is because no statistical differences were observed for the factors Solutions and Interactions (Species x Solutions) (Table 3). Second trial with radical exudates: When performing the statistical analyzes of the results obtained on the germination of the seeds in this test, it was observed that there were statistical differences for all the factors (Species, Solutions and Interactions) (Table 4).

Table 2 Comparison of Tukey's multiple range test, seed germination with treatment of radical exudates (juvenile phenological stage) of seneçon du cap plants. (1st trial)

Especie	Meanş	Groups
Barley	48.33	A
Medicago-salernes	46.22	A
Lettuce	46.22	A
Radish	42.22	B
Carrot	41.22	B
Brome cathartiques	35.00	C
Medicago-mauguio	30.22	D
Madicago-ampus	26.67	D
Seneçon du cap	23.11	E

Table 3 Analysis of variance of stem height of germinated seedlings with the treatment of radical exudates in the 1st. phenological stage of the plants of seneçon du cap. (1st trial)

	S.c.e.	Ddl	S. means	Test f	Probab
Var. total	6519.95	80	81.50		
V. especie	5677.28	8	709.66	66.15	0.0000
V. solution	55.88	2	27.94	2.60	0.0814
V.interacc	207.46	16	12.97	1.21	0.2918
V. residual	579.33	54	10.73		

Table 4 Analysis of variance of seed germination with the treatment of radical exudates in the 2nd phenological stage of seneçon du cap (2nd essay)

	S.c.e.	Ddl	S. means	Test f	Probab
Var. total	6687.78	71	94.19		
V. especie	5420.22	7	774.32	46.81	0.0000
V. solution	100.03	2	50.01	3.02	0.0566
V.interacc	373.53	14	26.68	1.61	0.1096
V. residual	794.00	48	16.54		

The statistical significance of the Species factor (Table 5), shows that there are differences in the germination of the different species, however, this is to be expected, because each species can have a higher or lower percentage of germination, typical of its species, but perhaps not due to the effects of radical exudates, which will need to be confirmed in the interactions of the Species and Solutions factors. However, it was observed that barley was the species with the highest germination and Seneçon du cap, which presented the lowest

germination, but statistically different. The results of the measurement of the hypocotyl size of the evaluated species showed statistical differences in the three factors (Species, Solutions and Interactions), as shown in Table 6.

Table 5 Comparison of Tukey's multiple range test, seed germination with the treatment of radical exudates (intermediate phenological stage) of seneçon du cap plants. (2nd essay)

Especie	Meanş	Groups
Barley	49.22	A
Lettuce	47.56	A B
Carrot	45.44	A B
Radish	44.22	B
Tomato	43.44	B C
Brome cathartiques	40.44	C D
Medicago-salernes	37.22	D
Madicago-ampus	26.67	D
Seneçon du cap	20.00	E

Treatments with the same letter are statistically the same

Table 6 Analysis of variance of the height of the stem of the germinated seedlings with the treatment of radical exudates in the 2nd phenological stage of the plants of seneçon du cap (2nd essay)

	S.c.e.	Ddl	S. means	Test f	Probab
Var. total	758.27	71	10.62		
V. espèce	719.16	7	102.74	388.71	0.0000
V. solution	18.44	2	9.22	34.89	0.0000
V.interacc	7.97	14	0.57	2.15	0.0248
V. residual	12.69	48	0.26		

However, the tendency observed when carrying out Tukey's multiple range tests (Table 7) is the same observed in germination, that is, that some plants have a larger hypocotyl size, due to the characteristics of the species, and perhaps not because of the effects of the radical exudates, in this sense, it is also observed that the barley, presented the largest plant size, while Carrot, Seneçon du cap and Medicago-salernes, presented the smaller size of hypocotyl.

Table 7 Comparison of Tukey's multiple range test, seed germination with treatment of radical exudates (intermediate phenological stage) of seneçon du cap plants. (2nd trial)

Especie	Meanş	Groups
Barley	12.33	A
Radish	6.44	B
Brome cathartiques	4.97	C
Tomato	4.41	D
Lettuce	3.67	E
Carrot	2.52	F
Seneçon du cap	2.18	F
Medicago-salernes	2.17	F

Treatments with the same letter are statistically the same

In the results obtained, on the effects of the Solutions, in the behaviour of the hypocotyl size of the species, it was observed in the analysis of variance that there are statistical differences for this factor (Table 8), where it is observed that the solution nutritive, favored a greater growth of the hypocotyl of all the plants, secondly the solution that contains the radical exudates, but statistically different from the first one, and of the distilled water, which was the least hypocotyl size presented by the plants. These results may indicate that the plants that grew in the solution containing the radical exudates, had a lower nutrient disposal, because the plants of *Seneçon du cap*, have extracted them from the nutrient solution and this has arrived with less nutrients, than the control nutrient solution and for the specific case of distilled water, it could be considered normal for plants that have a smaller hypocotyl size, mainly because they have grown only with water and without any nutritional supplement, compared with the two solutions previous, especially for the contents of nutrients of the same (Table 8A).

Table 8A Results of the multiple range comparison tests of the solutions used, with the height of the stem of the germinated seedlings with the treatment of radical exudates in the 2nd phenological stage of the plants of *seneçon du cap*. (2nd essay)

Solutions	Means	Groups
Nutritious solution	5.40	A
Radical exudates	4.93	B
Distilled water	4.17	C

Treatments with the same letter are statistically the same

Factor solutions

Factor interactions

Species x Solutions Finally, when observing in detail the behavior of the statistical analyzes, and the multiple range tests, of the Interactions, it can be verified that the behavior of the Species, with the Solutions, if there are statistical differences, but not by the effect of the exudates radicals, but plants grew less with distilled water or more with the nutritive solution, but in any case statistically equal to the treatment with radical exudates, as can be seen in the detailed grouping by species and solutions presented below (Table 8B).

Table 8B Detailed grouping by species and solutions presented below

Barley	Meanş	Groups
Nutritious solution	13.0	A
Radical exudates	12.4	A
Distilled water	11.53	B

Radish	Meanş	Groups
Nutritious solution	7.80	C
Radical exudates	6.3	D E
Distilled water	5.1	E

Tomato	Meanş	Groups
Nutritious solution	5.47	E
Radical exudates	4.43	E F
Distilled water	3.33	F

Brome cathartiques	Meanş	Groups
Nutritious solution	5.40	E
Radical exudates	5.23	E
Distilled water	4.27	E

Letucce	Meanş	Groups
Nutritious solution	4.23	F
Radical exudates	3.70	F G
Distilled water	3.07	G

Carrot	Meanş	Groups
Nutritious solution	2.77	G H
Radical exudates	2.67	G H
Distilled water	2.13	H

Seneçon du cap	Meanş	Groups
Nutritious solution	2.37	H I
Radical exudates	2.27	H I
Distilled water	1.90	I

Medicago	Meanş	Groups
Nutritious solution	2.40	I
Radical exudates	2.10	I
Distilled water	2.0	I

Third trial with radical exudates

The results of the statistical analyzes carried out on the germination of the seeds of plants, which were subjected to the treatment of the radical exudates of the *Seneçon du cap* plant, in the so-called 3rd. phenological stage (flowering), showed the following results (Table 9), where it is observed that there are statistical differences for the factor Species, so it was proceeded to perform the corresponding multiple range tests, to determine the differences between treatments.

Table 9 Analysis of variance of seed germination with the treatment of radical exudates in the stage of flowering of the *seneçon du cap* (3rd trial)

	S.c.e.	Ddl	S. means	Test f	Probab
Var. totals	7204.32	71	101.47		
V. especie	5495.65	7	785.09	27.53	0.0000
V. solution	69.44	2	34.72	1.22	0.3054
V.interacc	273.89	14	19.56	0.69	0.7762
V. blocks	53.69	2	26.85	0.94	0.3996
V. residual	1311.64	46	28.51		

Species factor

The analysis of the multiple range test of Tukey, on the Species factor, shows the differences between them, where it can be observed (Table 10), that the species of Barley, Lettuce and Radish, were the ones that presented the highest quantities of seeds germinated and are statistically equal. On the contrary, the species that presented the lowest amounts of germinated seeds were *Seneçon du cap* and

Medicago-salernes, which are statistically different from each other. However, it is believed that these differences between the species, in terms of the amounts of germinated seeds, is not due to the radical exudates of the Seneçon du cap, but rather to the characteristics of each species, since no differences were observed statistics on the factor called Interactions. The second parameter evaluated, which is the size of the hypocotyl, when performing the analysis of variance, presented the following results (Table 11), where the factors Species, Solutions and Interactions were observed, presented statistical significance, so they were practiced Tukey's multiple comparison test analyzes.

Table 10 Comparison of Tukey's multiple range test, of seed germination with the treatment of radical exudates (phenological flowering stage) of seneçon du cap plants (3rd trial)

Especie	Meanş	Groups
Barley	49.78	A
Lettuce	47.56	A
Radish	47.44	A
Brome cathartiques	40.67	B
Carrot	40.56	B
Tomato	39.33	B
Seneçon du cap	32.44	C
Madicago-salernes	21.44	D

Treatments with the same letter are statistically the same

Table 11 Analysis of variance of the stem height of the germinated seedlings with the treatment of radical exudates in the flowering stage of the seneçon du cap (3rd trial)

	S.c.e.	Ddl	S. means	Test f	Probab
Var. total	802.02	71	11.30		
V. especie	781.29	7	111.61	1549.54	0.0000
V. solution	9.19	2	4.60	63.82	0.0000
V.interacc	8.00	14	0.57	7.93	0.0000
V. blocks	0.23	2	0.11	1.57	0.2170
V. residual	3.31	46	0.07		

Species factor

Tukey's multiple range comparison analysis, between the different species, subjected to the treatment of the radical exudates of seneçon du cap, in the phenological stage of flowering, shows that the plants of Barley, Rabano, brome cathartiques and tomato, were the that presented greater hypocotyl sizes, in descending order, but all statistically different from each other. On the contrary, Cebada, Lechuga, seneçon du cap and Madicago-salernes, presented the smallest hypocotyl sizes and all are statistically equal to each other. In this case it will be important to observe the behavior of these results, in relation to the interaction they present with the factor Solutions, factors that also presented statistical differences (Table 12).

Factor solutions

When the analysis of Tukey's multiple range comparison test (Table 13A) was performed, to this factor, it was observed that the three solution levels are statistically different, that is, that the hypocotyls of the species grew differently in each type from solution.

However, it is important to note that the plants that germinated in the solution with the radical exudates were those that were larger and statistically different from the other two.

Table 12 Comparison of Tukey's multiple range test, seed germination with the treatment of radical exudates (phenological stage of flowering) of seneçon du cap plants (3rd trial)

Especie	Means	Groups
Barley	12.34	A
Radish	4.32	B
Brome cathartiques	3.26	C
Tomato	2.69	D
Carrot	2.28	E
Lettuce	2.27	E
Seneçon du cap	2.02	E
Medicago-salernes	1.74	E

Treatments with the same letter are statistically the same

On the contrary, the plants that grew in the distilled water solution were the ones with the smallest hypocotyl sizes.

By virtue of the above, it could be said that the radical exudates do not present any allelopathic effect, since it was precisely in that solution, where the plants grew the most.

Factor interactions: species x solutions

The detailed breakdown of Tukey's multiple range test, of the interactions between the species and the solutions, (all attached below), shows that the statistical differences observed in the analysis of variance, are due to the smaller size of the hypocotyl of the plants, when these germinated in distilled water, these results are very clear in the cases of the species of Barley, Radish and Tomato. On the contrary, the plants that germinated in the nutritive solutions and with the radical exudates, in these and the other species were statistically equal, this means that, in no case was a negative effect of the radical exudates observed in the growth of the hypocotyls of plants. That is, it does not cause any allelopathic effect in these plant species of these families, at least until the phenological stage of flowering (Table 13B). The analysis of variance of the results on the germination index of the seeds, during the seven days of the trial, show that there were only statistical differences for the factor Species (Table 14).

Table 13A Results of the multiple range comparison tests of the solutions used, with the height of the stem of the seedlings in the 3rd phenological stage (flowering) of the plants of seneçon du cap (3rd trial)

Solutions	Means	Groups
Radical exudates	4.20	A
Nutritious solution	4.03	B
Distilled water	3.37	C

Treatments with the same letter are statistically the same.

When analyzing the results of Tukey's multiple range test (Table 15), on the germination indexes, it is observed that the species with the fastest germination were, Barley, lettuce and Rabano, besides being statistically equal. While tomato and seneçon du cap, were the species that are slowest to germinate, regardless of the solution treatment they

receive. These results do not show that there have been effects on the part of the radical exudates in delaying the germination of any of the evaluated species.

Table 13B The detailed breakdown of Tukey's multiple range test, of the interactions between the species and the solutions

Barley	Means	Groups
Nutritious solution		A
Radical exudates		A
Distilled water		B
Radish	Meanş	Groups
Nutritious solution		C
Radical exudates		C
Distilled water		D
Tomato	Meanş	Groups
Nutritious solution		E
Radical exudates		E
Distilled water		G
Brome cathartiques	Meanş	Groups
Radical exudates		E
Nutritious solution		E
Distilled water		E
Lettuce	Meanş	Groups
Radical exudates		G
Nutritious solution		G
Distilled water		G
Carrot	Meanş	Groups
Nutritious solution		G
Radical exudates		G
Distilled water		G
Seneçon du cap	Meanş	Groups
Radical exudates		G
Nutritious solution		G
Distilled water		G
Medicago-salernes	Meanş	Groups
Nutritious solution		H
Radical exudates		H
Distilled water		H

Table 14 Analysis of variance of germination index of germinated seeds with the treatment of radical exudates in the stage of flowering of plants of seneçon du cap (3rd trial)

	S.c.e.	Ddl	S. means	Test f	Probab
Var. total	1039.73	71	14.64		
V. especie	876.00	7	125.14	47.20	0.0000
V. solution	3.40	2	1.70	0.64	0.5361
V. interacc	33.05	14	2.36	0.89	0.5743
V. blocks	5.33	2	2.66	I	0.3758
V. residual	121.96	46	2.65		

Table 15 Comparison of Tukey's multiple-range test, of seed germination indexes with the treatment of radical exudates (phenological stage of flowering) of seneçon du cap plants (3rd trial)

Especie	Means	Groups
Barley	16.56	A
Lettuce	15.67	A
Radish	15.65	A
Carrot	12.19	B
Brome cathartiques	11.52	B
Medicago-salernes	9.52	C
Tomato	8.17	C D
Seneçon du cap	6.64	D

Conclusion

As a result of the research work carried out with the radical exudates of the seneçon du cap plant, in three phenological stages (juvenile, intermediate and flowering), it was found that at least for the species used in the experimentation, it did not cause them an allelopathic effect, in none of the evaluated parameters, germination, hypocotyl growth or stem height.

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None.

Conflicts of interest

Authors declare that there is no conflict of interest.

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