Allelopathic potential of *Cynodon dactylon* (L.) Pers. on the germination and growth of durum wheat (*Triticum durum* Desf.)

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Abstract. In this work, we investaged laboratory tests for the evaluation of the allelopathic effect of aqueous extracts of *Cynodon dactylon* L. on the germination and growth of three variety (variety MBB, GTA DUR and VITRON). In general, an inhibitory effect is observed on all studied parameters namely germination, radicle length, coleoptiles length as well as the production of dry matter. This effect occurs at the lowest concentration (10 g/l) and the reduction rate increases with the increase of the concentration of the extracts (20 g/l, 30 g / l and 40 g/l).

Keywords. Allelopathy - Aqueous extract - *Cynodon dactylon* – Inhibition - Durum wheat.

Potentiel allélopathique du Cynodon dactylon* Pers.*, sur la germination et la croissance de blé dur (Triticum durum* Desf.*)

Résumé. *Dans ce travail, des essais au laboratoire pour l'évaluation de l'effet allélopathique des extraits aqueux de Cynodon dactylon* L.*, sur la germination et la croissance de trois variétés de blé dur (variété MBB, GTA DUR et VITRON). En général, un effet inhibiteur est observé, sur tous les paramètres étudiés à savoir la germination, les longueurs moyennes, de la radicule, et de la coléoptile ainsi que la production de matière sèche. Cet effet est apparu dès la concentration la plus faible (10g/l) et le taux de réduction augmente avec l'augmentation de la concentration des extraits (20g/l, 30g/l et 40 g/l).*

Mots clés. *Allélopathie - Extrait aqueux - Cynodon dactylon - Inhibition - Blé dur.*

I - Introduction

In Algeria, cereal farming remains the pivot of agriculture; it is a strategic sector and represents a considerable weight in the agricultural economy. It is the basis of the country's food security. Durum wheat and bread wheat are the most widely grown cereals for human consumption (Fourar-Belaifa, 2015).

Wheat occupies a very important place in the spatial structure of agricultural activity. It occupies about 50% of the cereal area sown, is more than 1.17 million hectares (MARDF, 2017).

In the Batna, the cereals occupy 130,524 ha of the total area of the farms, with a production of 291275 qx (ASD, 2018).

Cereal production in Algeria is still irregular and appears to be closely related to a number of factors, abiotic (irregular rainfall, agricultural techniques, etc.) and biotic (genetic potential, diseases, pests, and weeds) (Benabderrazik and Rastoin, 2014).

Among other things, cereals remain too sensitive to competition from weeds that can significantly affect yield and cause significant crop. Plants in a plot interfere with each other in different ways. In addition to the classic competition for water, nutrients, space and light, in recent years have shown an influence induced by chemical molecules, called allelopathy (Quartier and Hoffer, 2006). Allelopathy is an interesting phenomenon used as a promising technique for biological control. It is a set of direct or indirect biochemical interactions, positive or negative from one plant to another (RICE, 2012).

Weed control is a major concern for producers as it can greatly reduce yield and / or quality of the crop (Florent, 2006).

In this study, we studied the allelopathic effects of different concentrations of the aqueous extract of quack grass (*Cynodon dactylon* (L.) Pers) on the germination and growth of three varieties of durum wheat: Mohamed Ben Bachir (MBB) VITRON and GTA DUR.

II - Materials and methods

To test the allelopathic effect of *C. dactylon*, the leaves were collected in the east, Batna (6° 10'26 " E, 35° 33'21"N).

The leaves were dried in the open air in the dark at room temperature for five weeks. After drying, the plant material is grinded with an electric grinder and sieved with 0.75mm sieve, for finally obtaining a fine powder.

For the extraction by maceration we opted for the protocol described by Rsaissi *et al.* (2013), consisting to take fifty grams of vegetable powder (quack grass) and put it in 500ml of distilled water at the room temperature for 24 hours. After filtration on filter paper, the filtrate is centrifuged and stored at 4 ° C until use.

1. Test

Four different doses of *C. dactylon* (10, 20, 30, 40g / L) were tested on three varieties of durum wheat grains with three repetitions. The seeds were disinfected for 5 minutes in bleach and then rinsed three times. with distilled water. 20 seeds of each variety are then transplanted into Petri dishes, containing filter paper impregnated with 5 ml of extract. The Petri dishes were incubated for 10 days at 22 ° C. During this time measurements have been made on the germination rate, the growth of the seedlings (average length of coleoptiles and radical as well as the production of the dry matter).

All results were subjected to analysis of variance (ANOVA) followed by comparison of the 5% threshold averages.

III - Results

The allelopathic effect of *C. dactylon* on the germination and growth of three durum wheat variety (Mohamed Ben Bachir, GTA DUR and VITRON) was certain. The importance of the phenomenon depended on the concentrations of the aqueous extract of quack grass whatever the variety, the different concentrations exerted effects on all the parameters measured , but the high doses of 30 and 40g/l extract had greater allelopathic effects (Table 1).

Table 1. Variance analysis of effect of variety and extract on germination rate (GR), radical length (RL); coleoptiles length (CL) and dry matter (DM).

	Value of F			
	TG (%)	**MRL (Cm)**	**CML (Cm)**	**DM (mg)**
Varieties (V)	10.569***	3.086	5.090*	44.982***
Concentration (C)	2.920*	23.705***	135.483***	33.049***
Interaction (V * C)	0.064	0.206	1.911	2.690*

** Significant effect (Threshold of significance 5%), *** very highly significant effect.*

1. Effect of aqueous extracts of *C.dactylon* on the germination rate of the three varieties of durum wheat

All aqueous extracts of the dried leaves revealed allelopathic effects on germination of durum wheat even at the lowest concentration (10 g / l). The seed germination rate after 10 days was respectively for MBB and GTA DUR varieties 96.66%, 95% varieties, while VITRON variety the germination rate was 80%.

Statistical analysis showed a very highly significant effect at the 5% threshold for the variety factor (P = 0.000), significant for the concentration factor (P = 0.038). The GTA DUR and MBB varieties have a higher germination rate than the VITRON variety (Table 1).

We have noticed that the germination rate of wheat grains is a function of the concentration of the aqueous extract of the weed plant (Figure 1).

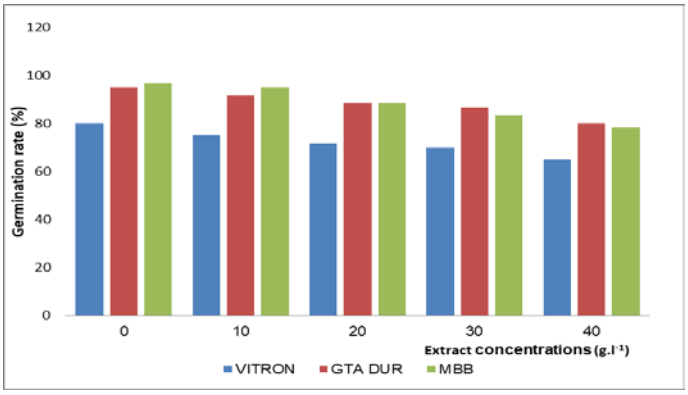

Figure 1. Effect of aqueous extract of *C. dactylon* on the germination rate of three varieties of durum wheat MBB, GTA DUR and VITRON.

2. Effect of *C.dactylon* extracts on the growth of durum wheat coleoptiles

The average length of the wheat coleoptiles was affected by the aqueous leaf extracts at the lowest concentration (10 g / l). However, the rate of reduction of this length varied according to the variety and concentration used. In the MBB variety, this rate varies between 25.79% and 68.07% with the concentrations 10 and 40g / l respectively followed by the GTADUR where this rate ranged between 10.75% and 66.71%. The VITRON variety records the most low percentage reduction (63.78%) at 40g / l concentration (Table 2).

The statistical analysis indicates that the different concentrations have a very highly significant difference (P = 0.0001), the variety factor is significant (P = 0.012) (Table 1).

3. Effect of aqueous extracts of *C. dactylon* on the growth of durum wheat radicle

The various dried plant extracts of *C. dactylon* showed an effect inducing a significant reduction of the concentration 10 g/ l. This reduction rate ranged from 25.03% (10g / l) to 85.55% (40g / l) in the MBB variety, followed by the GTA DUR with respective rates of 32.03% and 85.40%. At the high concentration (Table 3).

Table 2. **Effect of the aqueous extract of *C. dactylon* at different concentrations on the mean length of the coleoptiles of three varieties of durum wheat.**

Varieties	Concentrations	CML (Cm)	PR(%)
MBB 8,32 a	40	4.32^{A}	68,07
	30	6.67^{AB}	50,70
	20	7.06^{ABC}	47,75
	10	10.04^{ABCDE}	25,79
	0 ***	13.53^{DE}	00
GTA DUR 9,93a	40	4,80 ^{A}	66,71
	30	8,60 ^{ABCD}	40,36
	20	8,99^{ABCD}	37,65
	10	12,87 ^{CDE}	10,75
	0 ***	14,42 ^{DE}	00
VITRON 10,19a	40	5.52^{A}	63,78
	30	8,56^{ABCD}	43,83
	20	9,96^{ABCDE}	34,65
	10	11,70^{BCDE}	23,22
	0 ***	15,24 ^{E}	00

*CML: average length of the coleoptiles, PR: percentage of reduction, *** very highly significant. A, B, C, D, E: statistical groups*

The variety VITRON has an average length of the major radicle of 10,10 cm followed by the MBB 9, 33cm all concentrations combined.

Variance analysis shows that the concentration factor at a very highly significant difference (P≤0.0001).

Table 3. Effect of the aqueous extract of *C. dactylon* at different concentrations on the radical length of three varieties of durum wheat.

Varieties	Concentrations	MRL(cm)	PR
GTA DUR 8.52^{A}	40	2.25^{A}	85,40
	30	5.58^{B}	63,81
	20	8.88^{CDE}	42,41
	10	10.48^{EF}	32,03
	0 ***	15.42^{G}	00
MBB 9,33 ^{AB}	40	2.17^{A}	85,55
	30	7.19^{BCD}	52,13
	20	11^{EF}	26,76
	10	11.26^{EF}	25,03
	0 ***	15.02^{G}	00
VITRON 10,10^{B}	40	3.09^{A}	83,27
	30	6.16^{BC}	66,66
	20	9.46^{DE}	48,80
	10	13.26^{FG}	28,24
	0 ***	18.48^{H}	00

*MRL: average radical length, PR: percentage reduction, *** highly significant. A, B, C, D, E, F, G, H: statistical groups.*

4. Effect of aqueous extracts of *C. dactylon* on the dry matter

The results obtained on the allelopathic effect of the aqueous extract of quack grass on the production of dry matter (figure 2), revealed that the decrease of the dry matter durum wheat a function of the concentrations of the extract. In fact we noticed, that, the variety VITRON showed an increased effect compared to the varieties MBB and GTA DUR where 0.63 mg was recorded at the high concentration (40g / l) and a loss rate of the order of 91.90%.

The results of the variance analysis reveal that the concentrations and varieties have a very highly significant difference (P = 0.0001), and the interaction between the two factors significant (P 0.023) (table 1).

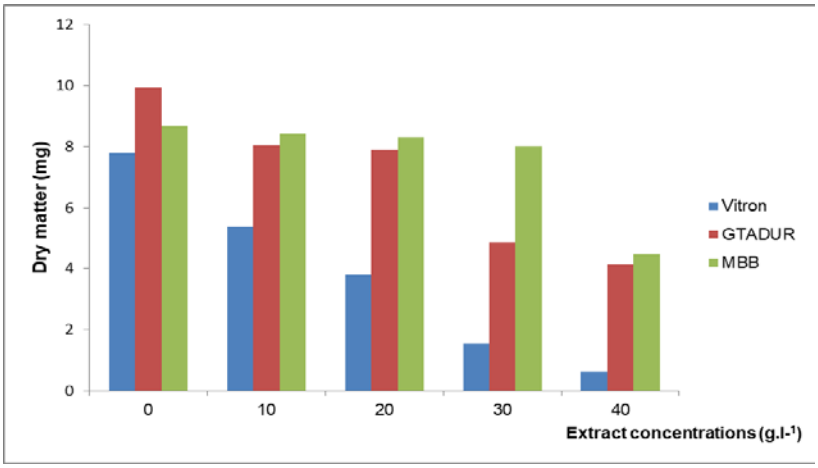

Figure 2. Effect of the aqueous extract of *C.dactylon* on the production of durum wheat dry matter.

IV - Discussion

This work determines the existence of an allelopathic phenomenon under experimental conditions, it provides proof that the quack grass contains allelochemical compounds whose action can potentially be carried out under natural conditions.

From a physiological point of view, germination begins with the beginning of seed imbibition and ends with the onset of growth marked by the lengthening of the radicle (Come, 1970).

The results revealed that germination, seedling growth and dry matter production were significantly inhibited by most aqueous extracts of *C. dactylon*. Indeed, these extracts are probably rich in allelochemicals. This inhibition varies according to the concentration used and the variety tested.

A delay or a stop in seed germination was observed with respect to the seeds of the controls. It is recognized that under natural conditions seed germination is a biochemical and physiological process where from the first contact of the seed with the exogenous stimulus (water), an amylase enzyme is synthesized and secreted in order to degrade starch (albumin) and provide the embryo with the energy necessary for germination (Regnault-Roger *et al*., 2008).

Viles and Reese (1996) reported that aqueous extracts of *Echinacea angustifolia* have the potential to prevent seed germination and seedling growth of *Lactuca sativa.*

Kil and Lee (1987) found that aqueous extracts of *Chrysanthemum morifolium* L. prevent seed germination of several species under experimental conditions.

The ability to inhibit seed germination is a complex process; several hypotheses can be raised including the ability of certain molecules in the extracts to inhibit the action of the enzyme amylase or to occupy their membrane sites or the antagonistic action of these molecules against growth hormones or the inhibition of their tissue actions (Feeny, 1976 in Benmeddour, 2010).

According to Kruse *et al*. (2000), when susceptible seeds are exposed to allelopathic substances, germination stops in the swelling stage of the grains. For others, germination stops at the beginning of the appearance of the radicle.

Seed germination and target plant growth have been widely accepted as key parameters for assessing the allelopathic potency of plants (Anjum and Bajwa, 2005).

Zahad *et al*. (2010) noted that the essential oil of *Schinus mollea* inhibited bread wheat germination *(Triticum aestivum)* and root elongation.

The phytotoxicity of leaves of *C .dactylon* was evaluated on durum wheat by testing their aqueous extracts which led to their defining a very interesting allelopathic potential confirming results of previous work (Macharia and Peffley, 1995, Lai *et al*., 2012) on lettuce *'Allium roseum* var. *grandiflorum*.

Germination is not the only stage of plant development that can be affected by allelopathic substances. The aqueous extracts of *C. dactylon* have a very pronounced negative impact on seedling growth (rootlet length, coleoptiles length and elaboration of dry matter).

The inhibitory effect observed with most aqueous extracts of *C. dactylon* was much more pronounced on the development of the aerial part (coleoptile) and the root than on germination. This is in agreement with the results of Hemada and El-Darier (2011), which confirm that germination is less sensitive than seedling growth (Sakka Rouis-Soussi *et al*., 2017).

The length of the radicle wheat is more affected than that of the aerial part (coleoptiles) by the majority of the aqueous extracts of *C. dactylon*. This is confirmed by Kato-Noguchi *et al*. (1994) who indicated that root growth is a more sensitive indicator of phytotoxicity than that of hypocotyl in its study of the allelopathic effect of *Allium roseum* var. *grandiflorum* on growing lettuce. In addition, allelochemicals are very active in meristematic tissues involved in root growth (Atoum *et al*., 2006). Such a result may be due to the fact that roots are the first to absorb allelochemicals from the environment (Ben Ghabrit *et al*., 2017).

The results obtained in this study showed that seedling development was inhibited, whereas high concentrations did not significantly affect the germination of durum wheat seeds. These observations are consistent with the observations of Macharia and Peffley (1995), who found that winter onion extract (*Allium fistulosum*) did not affect seed germination of *K. scoparia*, whereas it decreased significantly. the biomass of these seedlings. These results are also consistent with those of Dogan (2004) who demonstrated that *Raphanus sativus* extracts do not affect durum wheat germination, development is delayed, Kruse *et al.* (2000), have also shown that the effect of allelochemicals is manifested by morphological variations that are observed most often in the early stages of development.

The varieties tested did not behave in the same way with respect to the effect of the four doses of *C.dactylon* at the high concentration (40g / l), GTADUR has a germination rate of 80% followed by the MBB 78.33% and finally the VITRON variety.Regarding the average lengths be it coleoptiles or radical VITRON mark important values. The variety Mohamed Ben Bachir elaborates more dry matter followed by the GTADUR.

V - Conclusions

The test study of the inhibitory effect of aqueous extracts of *C. dactylon* on seed germination of the three varieties of durum wheat: MBB, GTADUR and VITRON under controlled conditions (laboratory) revealed that there is an inhibition of germination of the seeds according to different concentrations of the aqueous extract and to highlight the allelopathic power of the extracts obtained from the leaf parts of this weed on the durum wheat seeds .

The monitoring of some growth parameters made it possible to observe abnormalities in the lots treated with extracts at high concentrations (30 and 40 g / l) and even a reduction in dry biomass.

In the light of these results, it is interesting to conclude that the aqueous extracts of *C. dactylon* have an inhibitory effect acting even at low concentrations and thus prevent germination of hard wheat seeds.

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