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ORIGINAL ARTICLE

ALLELOPATHIC EFFECTS OF *NICOTINA GLUCA* AQUEOUS EXTRACTS ON GERMINATION AND GROWTH OF *ZEA MAYS* AND *DODONAEA VISCOSA*.

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Abstract:

Additionally, Zea mays was more tolerant of nut allelochemicals than Dodonaea viscoseThe radicle and plumule length also were significantly affected by the extract concentrations. The present study suggests that the N. glauca has allelopathic effect on the plants that live nearby. However, further study is needed to clarify the effect of N. glauca extract on metabolism and morphology various plants.

KEY WORDS:

Allelopathy, aqueous extracts, *Nicotinagluca*, germination, Growth.

INTRODUCTION

Allelopathy could be defined asan important mechanism of plant interference mediated by the addition of plantproduced secondary products to the soil rhizosphere(Weston,2005). These plants produced secondary products into the soil profile and impact the growth of plants that are growing near the allelopathic species (Akemo*et al*.,2000). Chemicals that impose allelopathic influences are called allelochemicals, which are generally considered to be those compounds (such as alkaloids, phenolics, flavonoids, terpenoids, and glucosinolates) (Singh and Ranjana, 2003 andKova´cik*et al*., 2007).Allelochemicals escape through the release l and artificial systems (Ferguson and Rathinasabapathi, 2009).

Many experiments showed that the allelochemicals may be present in all plant organs such as leaves, stems, roots, fruits, flowers and seeds, and their quantities (Dorning and Cipollini 2006 andTanveer*et al*., 2010) vary from one tissue to another (Hedge and Miller, 1990; Grisi*et al*., 2012). Among the different parts, Leaves appear to be the most consistent source of chemicals involved in phytotoxicity (Dorning and Cipollini 2006; Gella*et al*., 2013 andGulzar and Siddiqui, 2014).

Nicotianaglauca(tree tobacco)isan evergreen shrubs or small tree, growing fast up to 6 m tall and belongs to the Family Solanaceae (Mizrachi*et al.*, 2000).It branches profusely, and can grow vigorously to

3m, particularly after good rainfall events (Florentine and Westbrooke, 2005).The leaves are large, alternate, petiole, ovate, pointed and blue-green in color and the flowers are yellow and a fully grown plant can produce 10,000–1,000,000 seeds(Florentine and Westbrooke, 2005).

Nicotianaglaucais a very poisonous plant (Plumlee*et al*., 1993 and Mizrachiet al., 2000),because it contains the alkaloid anabasine(Sims *et al*., 1999). The native location is Argentine, but it is widely spread all over Arabian countries as Egypt, Yemen, Palestine, Tunisian, Jordan and Saudi Arabia (Alhammadi, 2010 andRinez*et al*., 2011). The plant becomes an obnoxious weed in Saudi Arabia especially in the Southwestern part(Alshahrani, 2008). This species is distributed in open and disturbed areas, including wastelands, roadsides (Boyland*et al.,* 1985 and Horton, 1985) from zero up to 2000 m (Medina, 1981(. The extensive amount of rainfall and moderate temperature may help the species invade new areas and expand its range(Alshahrani, 2008). Many studies found that the aqueous leachate of its parts exhibit allelopathic effects (Heisey and Delwiche, 1983; Florentine andWestbrooke, 2005;Alshahrani, 2008). The study's goal is to explore the possibility that the *Nicotianaglaucahas* allelophatic potential on germination and seedlings growth of *Zea maysand Dodonaeaviscosa* which had been done in laboratory conditions.

MATERIALS AND METHODS

Plants species:

Tow plant species were chosen for this study,Habash (*Zea mays*); which is a crop plant commonly cultivated in different agricultural areas in Al-Bahaprovince. While Shath (*Dodonaeaviscosa*), is a wild plant, grow naturally in the slopes of the high mountainssouth of Saudi Arabia. Germination of both species seedswas tested before use.

Preparation of plant extract:

Dry samples of leafs of *Nicotinagluca* were collected from the different hilly areas of Al-Baha province. Leafs werethoroughly washed with distilled water to remove all the dust and dirt particles and then were dried in drying oven. The leaves extraction of *Nicotinagluca* was prepared by soaking of amount of the dry leaf materials in distilled water (1:10 w/v)for 24 hours at room temperature. Extracts filtered by Whatman filter paper No.1 (Oudhia and Tripathy, 2001; Al-Zahrani and Al-Robai, 2007). Finally, extract diluted by distilled water to obtained concentrations of 10, 20, 40 and 80% then kept under 4ºC in the refrigerator. The distilled water was used as the control treatment.

Germination experiment:

Twenty seeds of the test plants were placed on filter paper inside a Petri-dish 9cm in diameter, and 15-20 ml of the leafs extract and distilled water for control treatment were constantly added. The experiment was checked every 24 hours and the seed counted to germinated when the radical appearance. The experiment was conducted with threereplicates. After 15 days,germinationpercent and germination rate were calculated according to Rho and Kil (1986) and Bradbeer (1988) respectively.

Seedling Growth:

The first five germinated seeds of each treatment were transferred into another Petri-dish, and the filter paper was constantly moistened using the respective extracts. After 15 days, radical and plumule lengths were measured and the average of radical and plumule length was calculated and expressed in centimeter.

Statistical Analysis:

Results obtained were treated statistically by applying probability using one way analysis of variance for each species with different concentrations where they were needed. Statistical analyses were performed using software SAS and Excel.

RESULTS

Germination percentage:

Seed germination percent of *Zea mays* and *Dodonaea viscose* is presented in Table (1) and Fig.(1). In control and 10% aqueous leaf extract concentration, germination percent values were 100%. The percentage was significantly reduced to 96.7%, 75% and 53% at 20%, 40% and 80% respectively. Whereas, the inhibition of germination was found strong in *Dodonaea viscose*, the decrease was 13.3% at 10% concentration compared to 91.7% germination in the control level. Additionally, there was complete absent of seed germination of *Dodonaea viscose* upon applying 20%, 40% and 80% aqueous leaf extract.

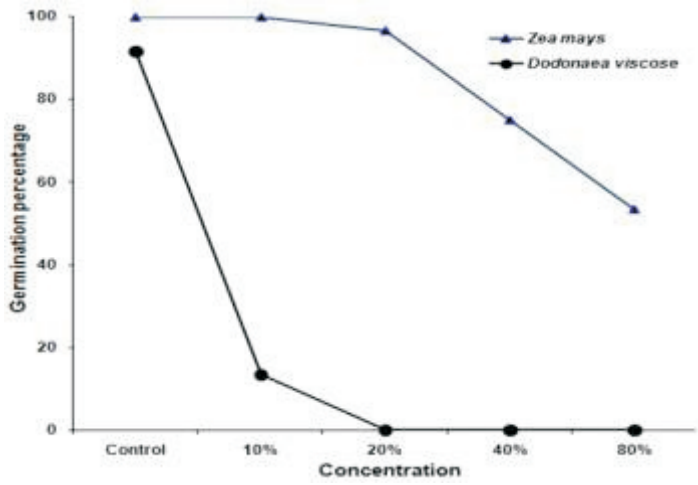

Fig. 1: Effect of different concentrations of aqueous extract of Nicotinagluca on Germination percent (cm).

GERMINATION RATE:

There was a significantly difference at $p<0.05$ between the effects of extract treatments and control on seed germination rate. As concentration of aqueous leaf extracts increases, the germination rate *Zea mays* and *Dodonaea viscose* was significantly inhibited as compared to control at the end of experiment Table (1) andFig.(2). Different concentration of leaf extract reduced the germination rate of *Zea mays* in 10 % to 23.94, 20% to 24.97, 40% to 21.97 and 80%to 14.8 respectively. While, the germination rate of *Dodonaeaviscosaseeds* was completely inhabited at 20%, 40% and 80% as compared to 10% concentration (7.84).

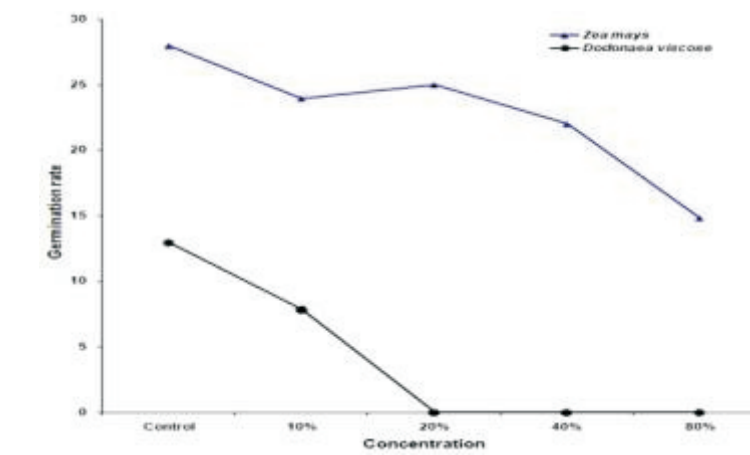

Fig. 2: Effect of different concentrations of aqueous extract of *Nicotinagluca* on Germination rate.

RADICAL LENGTH:

The effect of leaf aqueous extracts of *Nicotinaglucaon* Radical length of test plant species are shown in Fig.(3). The results revealed that the radical growth of *Zea mays* wasstopped at all concentrations except 10% concentration; the value of radical length was 13.7 cm at control level. Afterward, it significantly reduced to 3 cm at10% concentration. Whereas, the radical growth of *Dodonaea viscose* was completely stopped at the all concentrations of the aqueous leaf extracts of *Nicotinagluca.*

PLUMULELENGTH:

The results showed that the same trend was observed for treatment of seedlings with extract (10, 20, 40 and 80%) on plumule length. However, both test plants were completely suppressed by all concentrations of the aqueous leaf extracts of *Nicotinagluca* but in *Zea mays* the lowest concentration of the extract was found 2.1 cm as compared to the control (8.6 cm).

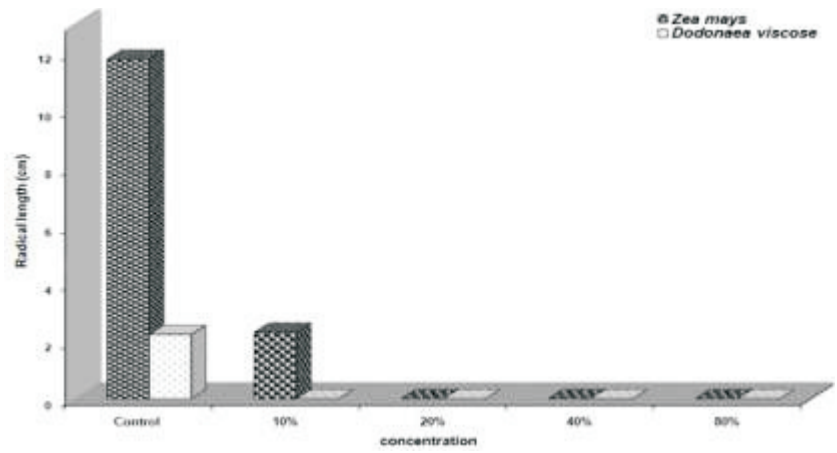

Fig. 3: Effect of different concentrations of aqueous extract of *Nicotinagluc*a on radical length (cm).

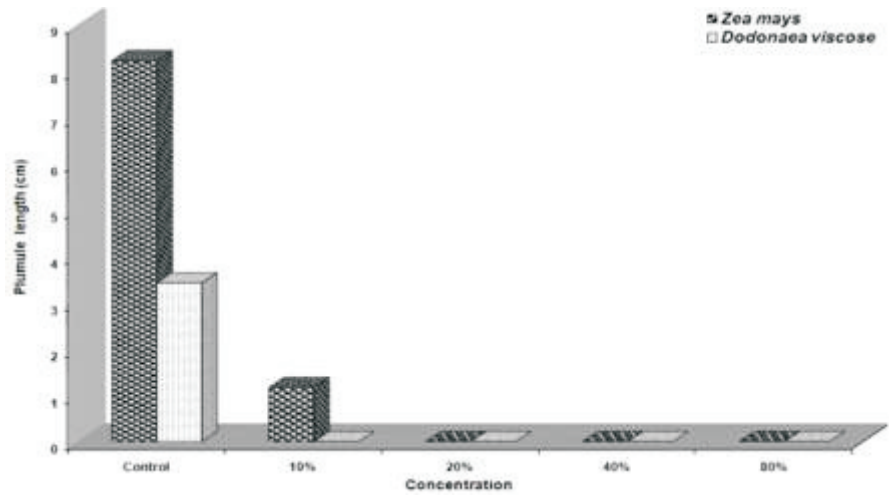

Fig. 4: Effect of different concentrations of aqueous extract of *Nicotinagluca* on plumule length (cm).

Table 1: Effect of different extracts concentration of *Nicotinagluca* on germination and seedling growth of *Zea mays* and *Dodonaeaviscose.*

Treatment	*Zea mays*				*Dodonaeaviscose*			
	GR	GS	RL	PL	GR	GS	RL	PL
Control	100[a]	27.95[a]	11.77[a]	8.23[a]	91.67[a]	12.93[a]	2.23[a]	3.43[a]
10%	100[a]	23.94[b]	2.30[b]	1.17[b]	13.33[b]	7.84[b]	0.00[b]	0.00[b]
20%	96.67[ab]	24.97[ab]	0.00[b]	0.00[b]	0.00[b]	0.00[b]	0.00[b]	0.00[b]
40%	75.00[ab]	21.97[b]	0.00[b]	0.00[b]	0.00[b]	0.00[b]	0.00[b]	0.00[b]
80%	53.33[b]	14.80[b]	0.00[b]	0.00[b]	0.00[b]	0.00[b]	0.00[b]	0.00[b]
F 0.05	6.91	20.59	229.79	265.65	143.45	203.70	280.56	116.58
LSD	24.633	3.2432	0.2712	0.6347	10.504	1.2067	0.1879	0.4116
Probability	0.0062	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

GP: Germination percentage, GS: Germination speed, RL: Radicle length, PL: Plumule length

DISCUSSION

The present investigation revealed that aqueous extract of *Nicotinaglucaat* various concentration levels inhibited the germination percentage. These results are in agreement to those obtained by Otusanya and Ilori (2014) who reported that the germination percentof two legumes and two cereals were significantly inhibited by the methanolic and water extracts of *Tithoniarotundifolia*. Moreover, Dhole et al. (2011) found that the seed germination of Sorghum vulgarewas completely inhibited by high concentration of water extract of weed species.

The reason for decreasing of germination was attributed to disturbances in phytohormone levels which lead to decreasing metabolic activity of the embryo through a disruption of normal cellular metabolism and blocking of its germination and growth (Bogatek and Gniazdowska, 2007). Additionally, the inhibition of seed germination was also attributed to the disruption of the activity of metabolic enzymes (Muscoloetal., 2001) and disruption of mitochondrial respiration (Podesta and Plaxton, 1994). Germinationof some species depends on ·-amylase activity that regulates starch break down, necessary for supplying substrates to respiration metabolism (Mohamadi and Rajaie, 2009).

This study has shown that germination rate of Zea mays was significantly inhibited with increasing of aqueous extract of *Nicotinagluca* leaves. Whereas, the germination rate of *Dodonaea viscose* was completely suppressed at all aqueous extract concentrations except10% concentration. These results are consistent with the findings of Khoshvaghti and Lotfi (2013) that germination rate of corn was significantly decreased with increasing of extract concentration of walnut leaves.

In general, the radical and plumule length of *Zea mays* and *Dodonaea viscose* was completely suppresed at the all concentrations of the aqueous leaf extracts of *Nicotinagluca* except *Zea mays* in 10% concentration. The same results recorded by (Zahedi and Ansari, 2011), the radical and plumule growth of Tomato, Cucumber and Cress completely suppressed at high concentrations of leave aqueous extract of *Malvasylvestris*. However, the reduction of seedlings length may be attributed to the reduced of cell division rate and cell elongation due to the presence of allelochemicals in the aqueous extracts (Rice, 1984; Einhellig, 1996;Javaid and Anjum, 2006).In addition, Tomaszewski and Thimann (1966)suggested that the decrease in plumule length induced by allelochemicals might be due to either the prevention of cell division and enlargement or by reduction of the stimulatory growth controlling effects of IAA and GA3. On the other hand, the inhibiting effect on radicle length of the seedlings could be due to the high accumulation of allelochemicals in the top meristems of the plants (Gella*et al*., 2013).Furthermore, Ismail and Chong (2002) found that the reduction in the growth may be due to allelopathy that induced inhibition of nutrient uptake. Nutrient uptake correlates with root characteristics such as root length and the increase in extract concentration reduced root length.

Some experiments showed that *Zea mays* was less negatively affected by extract of walnut leaves in comparison with soybeans (Jose and Gillespie (1998) and wheat (Khoshvaghti and Lotfi, 2013). This supports our conclusion that *Zea mays* is more tolerant of nut allelochemicals than *Dodonaea viscose*. However, the most common explanation for this variation in response would be the selectivity of allelochemicals for target plant species (Inderjit and Duke, 2003 and Noguchi *et al*., 2009) or the difference in sensitivity to allelochemicals of the test plant species (Noguchi *et al*., 2009). Additionally, Shaukat*et al*. (1983) suggested that the varied susceptibility of different species to such extracts has previously been attributed to inherent differences in physiological and morphological characteristics of test species.

CONCLUSION

The present study suggests that the *N. glauca* has allelopathic effect on the plants that live nearby specially the natural vegetation. However, further study is needed to clarify the effect of *N. glauc*a extract on metabolism and morphology of various plants.

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