

## Models Explaining the Allelopathic Coefficients between *Glycyrrhiza glabra* L. and *Cyperus rotundus* L. of Aqueous Extract and Residual Powder on Corn and Bean

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### ABSTRACT

In order to investigate models explaining the allelopathic effects of aqueous extract of different parts (Roots, Stems, Leaves and Flowers) of Licorice (*Glycyrrhiza glabra* L.) and Purple nut sedge (*Cyperus rotundus* L.) on germination rate, Root and Shoot length of Corn (Sc 704) and Bean (Cv Talash) experiment of based on Completely Randomized Design with four replications water), 25%, 50%, 75% and 100% of was conducted. treatments included control (distilled different parts of Licorice and Purple nut sedge. There were significant differences between germination rate, Root and Shoot length of Corn and Bean with different concentration of aqueous extracts of Licorice and Purple nut sedge, Results showed that increasing the extract concentration decreases seedlings growth. Linear models obtained based on regression analysis were almost significant in all cases and showing that Licorice and Purple nut sedge have significant allelopathic effects on Corn and Bean. Mean allelopathic coefficients of the effects of Licorice on Corn, Licorice on Bean; Purple nut sedge on Corn and Purple nut sedge on Bean was -5.68, -3.72, -1.10, -1.44 (unit) respectively. These allelopathic plants may be considered in producing organic herbicides.

**KEYWORDS:** Allelopathic Coefficients, Crop Species, Regression Models

### INTRODUCTION

The base of modeling in plants was established by Devit in 1960. The modeling has been made based on finding the logical relations and knowing them in different crop organizations and determining these relations by mathematical indicators. The term allelopathy is composed of Allelo (meaning: across) and Pathy (mean: having disease) so, its meaning could be Allelopathy. It is one of the important mechanisms which overcome the aggressive weeds in agricultural regions. Although, the weed do not include more than %1 of world species, but they make different problems in the processes of food production, health, economical stability and so on, weeds interfere in the growth of agricultural products annually and decrease %15 of product function [1]. One of the problems by weeds on agronomy plants is their preventive effects which are different based on the growth of plant. Allelopathic expression was used for the first time in 1937 by Han's mulish in Austria. All plant sections and organs include of Leaves, Stems, Roots, Rhizome, Flowers, Fruits and Seeds by and large comprise the allelopathy potential but seemingly, the Leaf are the main parts for producing allelopathy materials and have maximum subsequently the Roots have minimum quant [2,3]. Generally the plants release such materials to surrounding area during plant's debris decomposition through Root exudates, evaporation and leaching [4,2]. He used this term as plant biochemistry and the effect of mechanisms on each other [5]. Allelopathic is defined as direct indirect cross effect between two plants, to extent that special chemicals are produced by one plant and these allelopathic plants affect the physiological process of adjacent plants. Such process is one of the common plant ecological reactions [6]. Allelopathic materials which are produced by one plant may affect the adjacent plants as the volative materials; wash from leaves, secretion from root or by destruction of dead organs [7]. Although all organs of plants may contain the allelopathic materials, the leaves and roots are the best producing resources of allelopathic combinations [8]. The released materials of the environment by a plant could be affective in preventive or stimulating state on the weeds. Fuji et al. showed that some pharmaceutical plants are members of powerful Allelopathic plants [9, 10]. Sometimes one chemical produced material by a plant may be harmful for the other plant, but it may be useful for the third plant [11]. Mentioned that the weather conditions and genetic properties of a plant are important effective indicators on making and releasing the allelopathic materials [11]. The study about allelopathy was greatly considered by researchers in recent decades and its usage was common in weed management and increase of agricultural plant and keeping the species variety allelopathy is a substitute strategy for weed management and by using it in the future, the usage of traditional herbicides has decreased in the soil and biological herbicides will be substituted by the synthetic ones [12]. In this respect the allelopathy of weeds could discover the new natural herbicides and the preventives of growth. Today there are many researchers on the substitutive methods. The easiest method to study the allelopathy is the usage of additional plants [13]. The allelopathic cross effects among different plants is studied in natural and agricultural ecosystems. allelopathic could be considered as a part of cross among the agricultural plants or weeds so allelopathic could affect the economical function of agricultural plants. The recent researcher showed that it is possible to use the role of plant allelopathic in agriculture alternation to manage the

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weeds in ecosystem. So, this issue decrease the environmental pollutions emerged from the usage of herbicides to control the weeds. The usage of natural made herbicides from allelopathic compounds could be a suitable substitute for chemical herbicides. In agricultural ecosystems four states is considered for allelopathic: the effects of crop plants on weeds, the effects of weeds on crop plants, the effects of crop plants on crop plants and the effects of weeds on weeds. This research investigates the effects of Licorice and Purple nut sedge weeds allelopathic effect on crop Plants of Corn and Beans. This study evaluate allelopathic indicators by fitting the plain linier models between the extracts of Licorice and Purple nut sedge powders and the length of radicle and plumule of Corn (Single cross 704) and Bean (Talash) in experimental conditions.

## MATERIALS AND METHODS

The weeds of Licorice and Purple nut sedge are used for this experiment and they were collected from crop lands in Jiroft and the seeds (Corn and Bean) also provided from the seed Research center of Jiroft. After dividing different parts of two allelopathic species (Root, Leaf, Stem and Flower) every part was separately packed in paper packets and it was kept in a place with 70C<sup>0</sup>. After, all organs were exited and ground separately and the powder was prepared for the next stages. The stages of initial extracts preparation: Extract taking is a common and effective method of allelopathic material extraction to the extract, first the base extract solution was prepared then denser solutions were obtained to this purpose, 500 ml of distilled water was mixed to 30 g of powder obtained from the injury of organs. The heterogeneous solution was put on the shaker for two hours with the higher round of 3000/m, then it was filtered by whatman one paper. Regarding the previous studies and the effective available materials from the previous extract, zero, 25, 50, 75 and 100% concentrations were provided, (the % 0 solution was the control or distilled water). In densify stage the primary extract mixed in 1 to 3 with distilled water to obtain %25 solution, so the following solution were prepared: 2 to 2 (%50), 3 to 1 (%75) and %100 concentrations. The obtained solutions were shacked for 5 minutes in order to operate the liquidation operation. To sterilized of Corn and Bean seeds, first they were in whitex (%2) for two minutes, and then they sterilized by Benumial fungicides solution with 2000 concentrations for two hours. Then 2 filtered papers put on Petridis. Then the dishes put in a place with 150C<sup>0</sup> for sterilization with filter paper for 2 hours. First whatman one paper put on the sterilized Petridis, and then 5cc of every solution was poured in the dishes. And after removing the bubbles among the Petridis and filter paper, 10 seeds of Corn and 10 of Beans were planted and the Petridis were closed. Every day 2<sup>o</sup> of the same solution was added to every Petridis to engage the seeds to the allelochemical materials and evaporation and dehydration do not destroy the seedling. The seed growing operation carried out in every Petridis for the extract of weed plant organ. Then, four seedlings were selected random from every Petridis and then the mean of radicle and plumule length was measured by (cm) scale. The treatments include control (distilled water) and 25, 50, 75 and 100% extract concentrations of Licorice and Purple nut sedge (from different parts). It should mention that this plan had factorial arrangement in Completely Random Block experiment with four replications.

## RESULTS AND DISCUSSION

Regarding the following table, the variance analysis of data showed that there is a meaningful difference between different treatments of Licorice and Purple nut sedge regarding the Length of Root and Stem in Corn and Bean which is emerged from the effect of concentration increase of allelopathic materials. When the powder extract of Licorice extract (different parts) (Stem, Root, Leaf and Flower) were add as resources of allelopathic compounds on the Corn, there was a decrease in process of Root and Stem growth. Nursverti reported that the resulted aqueous extract of aerial and land organs of wild radish has decreased the germination and growth of some agronomy species seedlings. In the above study, the Cotton and Corn showed the highest decrease [14]. Another study carried out to investigate the effect of different concentrations of Root, Leaf and Stem extract of Sunflower on germination and growth of Canary grass, weeds, oxalis and alfalfa. The result of these studies showed that the extract of the above extract parts (of Sunflower) had preventive effect on seed germination and seedling growth of the above plants and oxalis plant had the highest influence [15]. The allelopathic indicator regarding the extract of Stem powder for the growth of Root and Stem was -10.8 and -4.27 respectively. Regarding the extract of Root powder, this indicator was -3.94 for the growth of Root growth and -2.92 for Corn. Regarding the Leaf extract, for the growth of Root, Stem growth was -6.09 and -4.4 respectively. About the powder extract of Licorice for the growth of Root and the Stem of Corn it was -8.79 and -4.28. When the powder of Licorice Stem was added as a resource of allelopathic compounds, the process of Root and Stem growth of Corn has decreased.

The allelopathic indicator of this case was -5.5 for the growth of Root and -2.93 for Stem, when the Root Licorice powder was added, the Root and Stem growth of Bean decreased. The allelopathic indicator in this case for the Root and Stem growth was -1.68 and -0.38 respectively. So, by adding the Leaf and Flower powder of Licorice extract as an allelopathic source, the growth process of Root and Stems (of Bean) decreased. The allelopathic indicator about the powder extract of Licorice Leaf for the growth of the Root and Stem was -6/78 and -3/78 respectively. The allelopathic indicator about the Licorice powder extracts, for the Root and Stem growth of Bean was -6.32 and -2.4 respectively. So, when the powder extract of Purple nut sedge (different parts) (Stem, Root, Leaf and Flower) are added as allelopathic compounds, the growth of Corn radicle and plumule has decreased, to extent that by increasing the Stem powder, the allelopathic indicator for the growth of Root and Stem was -3.06 and -1.73 respectively. By increase the powder extract of Purple nut sedge, this indicator became -1.65 and -0.97 for the growth of Corn Stem and Root. By increasing the

Leaf powder, the allelopathic indicator was -2.33 and -1.11 for the growth of Root and Stem. Also, by increasing the Flower powder, the process of Root and Stem grow of Corn has decreased. And the allelopathic indicator was -0.05 and -0.15 for Root and Stem growth. When the Stem powder of Purple nut sedge was added as a main allelopathic resource, there was a decrease in the Root and Stem growth of Bean. The allelopathic indicator in this case was -1.24 and -0.54 for Root and Stem growth. So, by increase of the Licorice Root, Leaf and Flower powder extract as sources of allelopathic compounds, The Root and Stem growth process of Bean decreased, to extent that the allelopathic indicator were -1.2 and -0.39 for the Purple nut sedge powder for Root and Stem growth. Also, this indicator was -2.78 and -1.27 about the Leaf powder extract for the Root and Stem growth of Bean.

Table 1. Regression Models indicating the allelopathic effects of Licorice on the seedling growth of Corn and Bean

Allelopathic plant	gromony plants	The source of allelopathic	Charactr	Equation	R <sup>2</sup>
Licorice	Corn	Stem powder	Root	$y=-10.8x+13.5$	0.9
		Stem powder	Stem	$y=-4.27x+6$	0.7
		Root powder	Root	$y=-3.94x+11.1$	0.2
		Root powder	Stem	$y=-2.92x+6.4$	0.3
		Leaf powder	Root	$y=-6.09x+12.0$	0.7
		Leaf powder	Stem	$y=-4.4x+6.9$	0.7
		Flower powder	Root	$y=-8.79x+13.7$	0.9
		Flower powder	Stem	$y=-4.28x+7.3$	0.8
	Bean	Stem powder	Root	$y=-5.5x+12.1$	0.6
		Stem powder	Stem	$y=-2.93x+6.1$	0.6
		Root powder	Root	$y=-1.68x+10.6$	0.06
		Root powder	Stem	$y=-0.38x+5.08$	0.02
		Leaf powder	Root	$y=-6.78x+12.3$	0.7
		Leaf powder	Stem	$y=-3.78x+6.6$	0.7
		Flower powder	Root	$y=-6.32x+13.4$	0.8
		Flower powder	Stem	$y=-2.4x+6.2$	0.3

Table 2. Regression Models indicating the allelopathic effects of Purple nut sedge on the seedling growth of Corn and Bean

Allelopathic plant	gromony plants	The source of allelopathic	Charactr	Equation	R <sup>2</sup>
Purple nutsedge	Corn	Stem powder	Root	$y=-3.06x+6.5$	0.9
		Stem powder	Stem	$y=-1.73x+3.1$	0.8
		Root powder	Root	$y=-1.65x+6.3$	0.8
		Root powder	Stem	$y=-0.97x+3.08$	0.9
		Leaf powder	Root	$y=-2.33x+6.38$	0.9
		Leaf powder	Stem	$y=-1.11x+3.06$	0.8
		Flower powder	Root	$y=-0.05x+5.17$	0
		Flower powder	Stem	$y=-0.15x+2.51$	0.01
		Stem powder	Root	$y=-1.24x+5.47$	0.03
	Bean	Stem powder	Stem	$y=-5.54x+2.62$	0.7
		Root powder	Root	$y=-1.2x+5.8$	0.5
		Root powder	Stem	$y=-0.39x+2.78$	0.8
		Leaf powder	Root	$y=-2.78x+5.6$	0.2
		Leaf powder	Stem	$y=-1.27x+2.64$	0.8
		Flower powder	Root	$y=-2.81x+6.04$	0.8
		Flower powder	Stem	$y=-1.32x+2.87$	0.9

## Conclusion

The aqueous extract of the Licorice and Purple nut sedge weeds have allelopathic effect on the seed germination and the growth of Corn and Bean radicle and plumule growth and decrease their growth. So, by increasing the concentration of aqueous available extract in different parts of the above plant, the amount of available preventive compounds in germination environment will increase, which had more preventive effect in the growth of radicle and plumule. On the other hand because of creating a more negative osmotic potential in germination environment, the amount of water absorption is decreased by the seed and at the result the metabolic actives are decreased like decomposing the larger compounds to the intermediate materials and their transfer to the place of embryo usage and the rupture of seed membranes, and exit of radicle and plumule has started too late, (as the final germination stage) and finally the seedling growth has decreased (radicle and plumule) [16]. The preventive effect of Licorice and Purple nut sedge different extract parts of the plant organs is not the same on the Root and Stem process of the above plants.

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