

# Studying Allelopathy Effect on Aquatic Extracts of Activity Substance for some plants on germination and growth of Date Palm Seedling *Phoenix dactylefera*

Samar Emad Ezzat<sup>1</sup>

<sup>1</sup>Al-Nissour University College, Al-Nisour University, Baghdad, Iraq

## Abstract

This study was conducted in the laboratories of biology Department of Education ibn alhaitham college in Baghdad University from September 2014 till March 2015 to study allelopathic effect of aquatic extracts of activity substance for root and vegetative parts of sunflower, Sorghum and corn on germination and growth of date palm seedling *Phoenix dactylefera*, fruits were collected from Rashdia area of Baghdad governate and seeds were gained after cleaning and drying. Anvils experiment was conducted using aquatic extracts of roots and vegetative parts of sunflower, sorghum and corn in concentration (2,4 and 8%) to seeds of date palm. Experiment was including 12 treatments with comparative treatments (only distilled water is added), The experiment was designed according to Complete Randomized Design (C.R.D.) with three replicates. Vegetative characters were studied using dry weight measurement for plants treated with aquatic extracts and the results were- 1. All anvils experiment characters for date palm seedlings had been impacted by aquatic extracts of activity substance for vegetative parts and root parts of sunflower, sorghum and corn in concentration (2,4 and 8%), and 2. Aquatic extrats for plants did not gave higher effect on number of leaves.

**Keywords:** Complete Randomized Design, *Phoenix dactylefera*, Sunflower, Sorghum, Corn

## 1. Introduction

The (*Phoenix dactylifera L.*) date palm is belonging to the genus *Phoenix*, which is having 14 species of generally wild or ornamental palms, with only *Phoenix dactylifera* being cultivated for its fruits. Palm tree is one of the oldest trees and work is being carried on it in science from ancient times [1,2].

In the world largest area for palm tree planting is in Iraq, as the numbers of palm trees have reached 16 million palms [3]. The dates containing large amounts of mineral salts and rare items so the dates are called miner [1], so they contain a high percentage of sugars that reach 75% of its dry weight [3] besides of large amount of vitamins such as thiamin, ribovlafin and niacin [4]. Due to the extreme importance of dates palm, the studies have confirmed that there are many agricultural plants effecting other plants next to it through release of allelopathic compounds to environment. Many studies indicated that some crops show height inhibition and reduction in growth of some plants because they contain secondary metabolites such as phenolic acids that show known allelopathic effect such as coumaric, alkaloids tannins [5,6] so that they lead to studying allelopathy and its effect in dates palm.

Allelopathy is mean mutual overlap between plants including harmful and beneficial effects among plants through chemical effects [7] allelopathy is different from competition, it is called non competition effect (it is mutual biochemical effect between neighbouring plants either inhibition or stimulation) [8] that is different from a competition (it is a situation that arise when the plants growing in one place when necessary factors for plant are not enough to fill the needs for all kinds of plant) [9]. Allelopathy compounds are secondary metabolites release from any part of the plant including leaves, stem and radicle as they are produced from plant whether it is alive or dead [10]. There are 2 kinds of allelopathic compounds, the first are releasing toxic substances in the same form as it was produced in plant and the second are the substances that will be toxic because of transformation process of these compounds [11] allelopathic compounds are classified depending on its chemical nature such as phenolic acids, alkaloids and terpenes [12,13] From sunflower, corn and sorghum

aquatic extracts of activity substances some phenolic acids are diagnosed like vanillic, ferulic and syringic acid [14,15] and because as these residues are kept in field after harvesting and ploughed with soil which induced researchers to study their effect on germination and growth of the dates palm, so the aim of this research is to study the physiology for dates palm (*Phoenix dactylefera*), and knowing effect of extracts on some crops that have allelopathic effect on germination and growth of those seedling.

## 2. Materials and methods

Sufficient quantity of *Phoenix dactylefera* dates was harvested during the ripening stage in September 2014 from the Rashdia area in Baghdad governorate, the seeds were taken out, washed well and all traces of the valuable tissues were removed and kept in a plastic bottle until use.

### 2.1 Collection of botanical samples

Sunflower, sorghum and corn residues were collected during Agricultural season 2014, the plants growth stage was the growth stage of flowers where they were uprooted with roots (vegetative system and root system), plants were washed well to remove impurities after that the root system was separated from the shoot system and flowers system and dried under the sun rays and cut into small pieces, and after that dried in electric oven at 700c for 3 days then, the samples were crushed by electric grinder of the type molix and kept in closed plastic cans until use and kept in cold and dry place.

### 2.2 Preparation of aquatic extracts

Aquatic extracts were prepared in concentration (2, 4, 8%) for each treatment used in the experiment (Table 1). Take 2 gram of different plant parts and mixed it with 100 ml of distilled water as prepared by [16] and the mixture (distilled water and plant powder) is taken in electric mixer for 15 minutes, then the sample is filtered by 3 layer gauze after that solution filtered by filter paper of Whatman no.1 type, special solution with all concentrations of plants and with all plant parts is put in glass bottle inside black sac and kept in refrigerator at 50°C until use.

### 2.3 Anvils experiment

Experiments were carried out using anvils experiment during agricultural season 2014 in plastic house of Ibn alhaitham education college of Baghdad university included study of aquatic extracts of activity, substance effect vegetative and the root system of sunflower, sorghum and corn on germination rate and physiology characters. The treatment applicated in experiment was anvils used in agriculture in 20 cm diameter and filled with clean mixture soil after mixed it with equal quantity of peat moss, the seeds are sown in pot, the number of seed is 25 for each treatment, then the plants were loosened to 5 plants for each treatment, aquatic extracts for treatment were added to the anvils after germination, after that the anvil were irrigated.

**Table 1.** Number of plantlets used per root and vegetative system of sunflower and wheat plant

Sr. No.	Plant	Part used	Concentrations (%)	No of plantlets
1	Sunflower	Root system	2	05
			4	05
			8	05
			Control	05
		Vegetative system	2	05
			4	05
			8	05
			Control	05
2	Wheat	Root system	2	05
			4	05
			8	05
			Control	05

		Vegetative system	2	05
			4	05
			8	05
			Control	05
3	Corn	Root system	2	05
			4	05
			8	05
			Control	05
		Vegetative system	2	05
			4	05
			8	05
			Control	05

After 3 months, germination rate (%), plant length (cm), number of leaves, dry weight for vegetative system and dry weight for root system were measured.

The germination rate (%) of plants are recorded after 14 days of seeds cultivation as equation percentage rate for germination = number of germinated seeds / number of cultivated seeds x 100 [17]. This formula is used for determination of rate percentage of germination. Dry weight for vegetative system were measured by taking each part separately and putting in aluminium foil, then drying in electric oven for 72 hours at temperature (70°C) and their dry weight is recorded by electric balance [16].

### 2.3 Statistical analysis

An experiment was conducted by Completely Randomize Design (C.R.D) by using an analysis of variance test (ANOVA), the difference is tested between account intermediate at probability level 0.05 by using polynomial Dankn test [18].

## 3. Results

### 3.1 Effect of sunflower aquatic extracts in germination and growth of date plant

**Germination rate (%):** Results showed the extracts of sunflower roots in concentration 2% lead to significant decrease in the rate of germination as it shows 55% decrease as compared to control which is 100% (Table 2), vegetative system for sunflower in concentration 2% lead to decrease significantly germination rate as it reached 60% compare with control that reached 97% (Table 2).

**Plant length (cm):** Results showed that treatment with sunflower root system in concentration 2% lead to significant decrease in plant length as it reached 14.3 cm compare with control that gave higher length 30.2 cm (Table 2), but vegetative system of sunflower in all concentration showed significant difference compared with control treatment that reached 29.3cm (Table 2)

**Number of leaves:** Results showed that extracts of vegetative and root system of sunflower do not show significant effect on number of leaves may be due to weak effect of aquatic extracts in 2, 4, 8 % concentration for these plants and consequently no effect on number of leaves was seen (Table 2)

**Dry weight for vegetative system (gm):** Results showed the root system for sunflower in concentration 4% lead to decrease significantly dry weight for vegetative system, it reached 0.80g compare with control that gave 1.32g (Table 2) Vegetative system for sunflower in concentration 4% lead to decrease significantly dry weight for vegetative system, as it reached 0.73g compare with control that reached 1.31g (Table 2).

**Dry weight of root system (gm):** Results showed that root system of sunflower in all concentrations showed significant decrease in dry weight for root compared with control that weighed 0.59g (Table 2), but vegetative

system of sunflower in concentration 4% showed significant decrease in dry weight for roots as it weighed 0.21g compared with control that weighed 0.61g (Table 2).

**Table 2. Effect of addition of aquatic extract of activity substance of sunflower in growth characters of date plant**

Extracts	Con. (%)	Germination rate (%)	Plant length (cm)	Leaves number	Vegetative system DW (gm)	Root system DW (gm)
Root system	2	55d	14.3c	3a	1.00b	0.20b
	4	79c	24.2b	4a	0.80c	0.22b
	8	87b	25.1b	4a	1.00b	0.22b
	Control	100a	30.2a	4a	1.32a	0.59a
Vegetative system	2	60d	15.0b	4a	0.94b	0.33b
	4	75c	15.9b	4a	0.73c	0.21c
	8	89b	17.7b	4a	0.95b	0.34b
	Control	97a	29.3a	4a	1.31a	0.61a

DW: Dry weight, Means sharing the same superscript letters under the same column do not differ significantly at  $P < 0.05$ .

### 3.2 Effect of aquatic extracts of sorghum on germination and growth

**Germination rate (%):** Results showed the extracts for root system of sorghum in concentration 2% lead to significant decrease in the rate of germination as it showed 60% compared with control that showed 100% (Table 3), vegetative system for sorghum in concentration 2% shows significant decrease in rate of germination as it reached 48% compare with control that reached 98% (Table 3).

**Plant length (cm):** Results showed the root system for sorghum in all concentrations shows significant decrease in plant length compared with control that gave higher length 30.5 cm (Table 3), also vegetative system of sorghum in all concentration showed significant decrease compared with control treatment that reached 31.7cm (Table 3).

**Number of leaves:** Results showed the vegetative and root system of sorghum don't significantly affect number of leaves may be due to weak effect of aquatic extracts for these used plants in given concentrations and consequently no effect on number of leaves is seen (Table 3)

**Dry weight of vegetative system(g):** Results showed the root system of sorghum in 2% concentration shows significant decrease in dry weight for vegetative system, that weighed 0.54g compared with control that weighed 1.32g (Table 3). Vegetative system for sorghum in 2% concentration lead to significant decrease in dry weight for vegetative system, as it weighed 0.71g compared with control that weighed 1.33g (Table 3).

**Dry weight of root system (gm):** Results showed the root system for sorghum in all concentrations showed significant decrease in dry weight for root compared with control that weighed 0.60g (Table 3) but vegetative system of sorghum in concentration 2% showed significant decrease in dry weight of roots as it weighed 0.22g compared with control that weighed 0.61g (Table 3).

**Table 3: Effect addition aquatic extract of activity substance for sorghum in growth characters of date plant**

Extract	Con. (%)	Germination rate (%)	Plant length (cm)	Number of leaves	Vegetative system DW (g)	Root system DW (g)
Root system	2%	60d	22.4b	3a	0.54c	0.41b
	4%	89b	22.1b	3a	0.98b	0.43b
	8%	75c	23.3b	3a	0.99b	0.45b

	Control	100a	30.5a	3a	1.32a	0.60a
<b>Vegetative system</b>	2%	48d	21.9b	3a	0.71c	0.22c
	4%	72c	22.8b	3a	0.90b	0.45b
	8%	85b	22.4b	2a	0.92b	0.44b
	Control	98a	31.7a	3a	1.33a	0.61a

DW: Dry weight, Means sharing the same superscript letters under the same column do not differ significantly at P<0.05.

### 3.3 Effect of aquatic extracts for yellow corn on germination and growth

**Germination rate (%):** Results showed that extracts of root system of corn in 2% concentration showed significant decrease in the rate of germination as it reached 79% compared with control that reached 95% (Table 4), the vegetative system for corn in all concentrations showed significant decrease in germination rate compared with a control that reached 100% (Table 4)

**Plant length (cm):** Results showed that root system of corn in 4% concentration showed significant decrease in plant length as it reached 16.2 cm compared with control that gave higher length 31.3 cm (Table 4), but vegetative system of corn in 2% concentration showed significant decrease in height of plant as it reached 15.2 cm compared with control treatment that reached 30.2cm (Table 4).

**Number of leaves:** Results showed that vegetative and the root system of corn doesn't show significant effect on the number of leaves may be due to a weak effect of aquatic extracts of these plants in given concentrations and consequently no significant effect was appeared on a number of leaves (Table 4)

**Dry weight of vegetative system (gm):** Results showed that the root system of corn in 2% concentration showed significant decrease in dry weight of vegetative system, it weighed 0.79 g compared with control that weighed 1.30g (Table 4). A vegetative system of corn in 2% concentration showed significant decrease in dry weight of vegetative system, as it weighed 0.59g compared with a control that weighed 1.33g (Table 4).

**Dry weight for root system(g):** Results showed that root system of corn in 4% concentration showed significant decrease in dry weight of roots as it weighed 0.22g compared with control that weighed 0.62g (Table 4) but the vegetative system of corn in all concentrations showed significant decrease in dry weight of root compared with a control that weighed 0.60g (Table 4).

**Table 4: Effect addition, aquatic extract of active substance for yellow corn in growth characters of date plant**

Extracts	Con. (%)	Germination rate (%)	Plant length (cm)	Number of leaves	Vegetative system DW (g)	Root system DW (g)
Root system	2%	79c	25.2b	2a	0.79c	0.45b
	4%	81b	16.2c	3a	1.00b	0.22c
	8%	82b	25.4b	3a	1.11b	0.46b
	Control	95a	31.3a	3a	1.30a	0.62a
Vegetative system	2%	63b	15.2c	3a	0.59d	0.41b
	4%	65b	22.1b	2a	0.71c	0.43b
	8%	59b	22.5b	3a	0.92b	0.41b
	Control	100a	30.2a	3a	1.33a	0.60a

DW: Dry weight, Means sharing the same superscript letters under the same column do not differ significantly at P<0.05

#### 4. Discussion

The treatment with root extracts of sunflower germination rate results in 2% concentration shows significant 60% germination rate as compared to control which is 97%. This result corresponds with [19] they found sunflowers aquatic extracts of root and vegetative system inhibited germination and growth for *Anagerus foetida*, studies showed the aquatic extracts for sunflower have the clear allelopathic effect of wheat and that gave positive indicator in possibility this phenomenon to struggle jungle [20].

The plant length results treated with root extracts of sunflower in 2% concentration shows significant decrease as it shows 14.3 cm length for treated and 30.2 cm length of control. A vegetative system of sunflower shows significant difference, that corresponds with [21] the addition of sunflower extract of its root and vegetative system inhibited plant length for 2 classes of wheat in percentage for Abu-garib (4.40, 7.24%) and for Ebah class (5.45, 9.34%). The results of the dry weight of root system and vegetative system of sunflower shows significant decrease in dry weight that corresponds with [24] addition of the extract vegetative group for sunflower into the seeds of jungle with thin leaves leaf inhabitation of dry weight for root and vegetative system in percentage 66.30%. As some germination inhibiting compounds are found in root secretions of sunflower which reduced wet and dry weight for yellow corn and wild oat [22,23]. Extracts of sunflower with its root and vegetative system lead to reduce root length because it increases oxynolytic enzyme that reduced root growth and consequently decrease its dry weight [25,26].

The results of effect of aquatic extracts of sorghum on growth and germination shows that, effects of rate of germination of root system extracts shows significant decrease as 60% compared with control (100%) and vegetative system at 2% concentration of vegetative system shows significant decrease, This corresponds with study that the addition of sorghum residue (root and vegetative system) shorten germination and growth of wheat [27] besides to existence poisonous existence in natural extracts for stem of sorghum that diagnosed by HPLC and that were all have phenolic nature [28] consequently affected on seed germination more than root system for white corn. Effect of sorghum aquatic extracts of root system shows significant decrease and vegetative system also shows significant decrease, this corresponds with the study about allelopathic effect on root, stem and leaf extracts for sorghum in jungle, in green house which showed that there is activity by extract on special kind of jungle more than other kinds as it inhibited the vegetative growth of *Impomoea tribola* more than *Echinochloa colonum* and *Rotlohlia cochinchineasis* [29].

Root system for sorghum in concentration 2% shows significant decrease in dry weight for vegetative system and Vegetative system for sorghum in concentration 2% lead to significant decrease in dry weight for vegetative system. It was observed that spray of sorghum extract on mash jungle after (15,30,45) days, the dry weight for berbeen jungle were lowered in percentage (60,75%) consequently but it don't effect on *Trianthema* jungle [30]. Root system for sorghum in all concentration showed significant decrease in dry weight for root system but vegetative system of sorghum in concentration 2% showed significant decrease in dry weight of roots as showed in study similar as present work, the roots gets affected more than other parts because it is having direct contact with allelopathic compounds that are released from plants into the growth medium so the effect of allelopathic compounds depends on natural compounds present in parts of plants [31] that corresponds with recent study including addition of white corn residue (root and vegetative system) for wheat that reduced dry weight for seedling and residues of root system for sorghum gave higher reduction in dry weight for Abu-damim jungle after 60 days in percentage 13.08% and on the wild oat in percentage 62.20% compared with control [27]. Root system of corn in 2% concentration showed significant decrease in the rate of germination and vegetative system for corn in all concentrations showed significant decrease in germination rate, similar results as Aquatic extracts of root and vegetative parts of corn inhibited germination and growth of wheat were found by [32] as corn residues tested and separated by PC, GC and TLC some of the organic acids and some of the phenolic acids are diagnosed. Root system of corn in 2% concentration showed significant decrease in dry weight of vegetative system and vegetative system of corn in 2% concentration showed

significant decrease in dry weight vegetative system. This may be due to these extracts preventing absorption of food substances and consequently reducing vital activity and reducing growth and dry substance is collected from the vegetative part [34]. The root system of corn in 4% concentration showed significant decrease in dry weight of roots, but vegetative system of corn in all concentrations showed significant decrease in dry weight of root. Similar results showed by study indicating that the roots gets affected more than other parts because it contacts with allelopathic compounds that are released from plants into the growth media so the effect of allelopathic compounds depends on natural compounds in parts of plant [31] jungle after 60 days in percentage 13.08% and on the wild oat in percentage 62.20% compared with control [27].

Muhammad and Majid, 2014 in their work concluded that the allelopathic effect of aqueous extracts of leaf, shoot and root against maize and wheat in sequence FAE < DAE and root < shoot < leaf; corresponding to delayed and lowered plumule and radical lengths, germination indices, germination and significantly low dry biomass of tested seedling of plant in the experiment of seed bioassay. Field trials were demonstrated for further explanation of the allelopathic action of sunflower on maize and wheat. Majeed et al., 2017 in their study on the sugarcane allelopathic effect on wheat concluded that various plant parts of sugarcane show both inhibitory and allelopathic effect against wheat in a bioassay of germination. Indicating similar and different results also like present study. Stem and root, peel extracts at greater concentration enhanced seedling dry biomass, seminal root and shoot growth and germination time, but negative effect was observed on leaf extracts on these parameters.

## Conclusion

All field characters of dates palm seedling are affected by aquatic extracts of sunflower, sorghum and corn and aquatic extracts of active substance in mentioning plants don't show significant effect on the number of leaves. The study can be effectively demonstrated that the date palm germination and growth is affected by the crop plant residues. To conduct future studies about possibility using these extracts in form accompanying pesticides in struggle jungle to reduce a pollution in the environment beside of the cost.

## Appendix

Appendixes, if needed, appear before the acknowledgment.

## References

- [1] Salomón-Torres, R.; Krueger, R.; García-Vázquez, J.P.; Villa-Angulo, R.; Villa-Angulo, C.; Ortiz-Uribe, N.; Sol-Uribe, J.A.; Samaniego-Sandoval, L. Date Palm Pollen: Features, Production, Extraction and Pollination Methods. *Agronomy* 2021, 11, 504.
- [2] Alsamarraee, Samira Moeaad. (2008). Detected level food media salt MS appropriate to originate primary buds for date palm *Phoenix dactylefera* in vitro, master thesis Ibn alhaitham education college, Baghdad university, Iraq.
- [3] Alrahbani, Ziad. (2010). [www.allitihad.com/paper.php?Name=article-Cached-similar](http://www.allitihad.com/paper.php?Name=article-Cached-similar)
- [4] Rivera, D and Rois, S. (2008). Distribution production of palm in the world. Minnesota university
- [5] Harborne, J.B. (1984). *Phytochemical Methods. A guide to modern techniques of plant analysis.* (2nd ed.) Chapman and Hall, London: 282.
- [6] Goodwin, T.W. and Mercer, E.I. (1985). *Introduction to plant Biochemistry.* (2nd ed) Pergamon press. London.
- [7] Molisch, H. (1937). "Der Einfluss einer pflanze auf die andere allelopathie". Fischer, Jena (Cited by Rice, 1974).
- [8] Tabash, Samir and Almaghribi, Sabah (2005). Effect competition by secretion inhibition substances for some harmful grasses. *Alasad magazine for engineering, science Syria.* No.22
- [9] Andrew J. Price, Maria, E.; Stoll, Jason, S Bergtold, Francisco, J. Arriagal, Kipling, S. Baalkom 1, Ted S. Kornecki 1, Randy, L. Raperl 1. (2008). Effect of cover crop extracts on cotton and radish radical elongation *International Journal of the Faculty of Agriculture and Biology, Warsaw University of Life science* Vol. 3, No. 1, pp. 60-66.
- [10] Witt, W.W. (1999). *Allelopathy. Integrated Weed Management.* AGR, 404PP.
- [11] Harborne, J.B. (1984). *Phytochemical Methods. A guide to modern techniques of plant analysis.* (2nd ed.) Chapman and Hall, London: 282.
- [12] Goodwin, T.W. and Mercer, E.I. (1985). *Introduction to plant Biochemistry.* (2nd ed) Pergamon press. London
- [13] Rice, E.I. (1984). *Allelopathy.* 2nd Edn. Academic Press. New York.

- [14] Guenzi, W.D. and Mc calla, T.M. (1966). Phenolic acids in Oat, Wheat, Sorghum and corn residues and their phytotoxicity. *Agron. J.*, 58: pp-303-304.
- [15] Chou, C.H. and Lin, H.J. (1976). Autointoxication mechanism of *Oryza sativa*. I. Phytotoxic effects of decomposing rice residues in soil. *J. Chem. Ecol.*, 2: pp-353-367.
- [16] Mersie, W. and Singh, M. (1987a). Allelopathic effect of *Parthenium hysterophorus* L. Extract and Residue on some agronomic crops and weeds. *J. Chem. Ecol.*, 13: pp-1739-1746.
- [17] Saied, S.M. (1984). Seed technology studies, seed vigour, field establishment and performance in cereals ph. D. thesis., 363.
- [18] Alrawi, Khasheh Mahmood and Abd Alazez Mohamed Khalaf Allha (2000). Design and analysis agriculture experiment. Book home printing, mousil university- ministry of high education. Republic of Iraq.
- [19] Alazawy, Samar Emad. (2015). Effect aquatic extracts for sunflower and white corn in physiology characters and activity substances for *Anagyrus foetida*, PHD Athesis, education college, Tikrit university, ministry of higher education. Iraq.
- [20] Rizvi, S.G.H., and Rivzi, V. (1992). Allelopathy: Basic and applied Aspects. Chapman and Hall, London, U.K.
- [21] Alshalabi, Faeq Tawfeq and Faeza khalil Esmaeel. (2009). Activity effect for sunflower and its effect in growth bread wheat. *Iraqi Agriculture Science Magazine*, 40 (5): pp-143-135.
- [22] Leather, G.R. (1983). Sunflower (*Helianthus annuus*) are allelopathic to weeds. *Weed Sci.*, 31: 37-42. Irons, S.M. and Burnside, O.C. (1982). Competitive and allelopathic effects of sunflower *Helianthus annuus*. *Weed Sci.*, 30: pp-372-377.
- [23] Irons, S.M. and Burnside, O.C. (1982). Competitive and allelopathic effects of sunflower *Helianthus annuus*. *Weed Sci.*, 30: pp- 372-377.
- [24] Alnaserri, Noor Ali. (2013). Using aquatic extracts for some plant in growth bread wheat *Triticum aestivum*. Master athesis. Agriculture college, Tikrit university. Iraq
- [25] Bogatek, K.R.; A. Gniazdowska; W. Zakzewska and K. Oracs. (2006). Allelopathic effect of sunflower extract on mustard seed germination and seedling growth *Biologia Plantarum*, 50(1): pp-156-158.
- [26] Alshahat, Naser Abu Zaid. (2000). Plant hormones and agriculture application. Science house for spread and distribution, Egypt, pp-366-373.
- [27] Hozayn, M.; abd El-Monem, A.A. and abd-Lateef, E.M. (2011a). crop residue, an effective tool for improving growth of wheat and suppression of some associated weeds.
- [28] Cheema, Z.A. (1988). Weed control in wheat through sorghum Allelochemical. Ph.d. Thesis, department of Agronomy, University of Agriculture Faisalabad, Pakistan. After Jamil, M. 2004.
- [29] Kim, S.Y.; De Datta, R.P.; Roble, S.k.; Kim, S.C.; Lee, S.C. and shin, D.h. (1993). Allelopathic effects of sorghum extract and residues on selected crops and weeds. *Korean J. of Weed Sci.*, 14: pp- 34-41.
- [30] Cheema, Z.A.; Rakha, A. and Khaliq. (2000a). Use of sorghum and sorghum mulches for weed control in mug bean. *Paki j. of agric sci.*, 37: pp-140-144.
- [31] Waller, G. R., and Nowacki, E. K. (1975). Alkaloid biology and metabolism in plants. New York: Plenum Press.
- [32] Saeed, Jenan Abdulkhalic. (1988). Effect of residues and aquatic of plant and soil for some crops on germination and growth of two calasses of wheat *Triticum astivum*, master Athesis, science education, Mousil university, Ministry of higher education, Iraq.
- [33] Chou, C.H., and Patrick, Z.A. (1976). Identification and phytotoxic activity of compounds produced during decomposition of corn and rye residues in soil. *J. Chem. Ecol.*, 2: pp-369-387.
- [34] Li, Z; Q. Wang ; X. Ruan ; C.D. pan and A. Jiang. (2010). Phenolics and Allelopathy. *Molecules* 15: pp-8933-8952.
- [35] Muhammad, Z., & Majeed, A. (2014). Allelopathic effects of aqueous extracts of sunflower on wheat (*Triticum aestivum* L.) and maize (*Zea mays* L.). *Pakistan Journal of Botany*, 46(5), pp-1715-1718.
- [36] A. Majeed, Z. Muhammad, M. Hussain, H. Ahmad, In vitro allelopathic effect of aqueous extracts of sugarcane on germination parameters of wheat, *Acta Agric. Slov.* 109 (2017) pp-349–356.