# Effect of Allelopathic Potential of Cabbage on Germination and Seedling growth of Three weeds

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**Abstract:**

It was evident that final germination, plumule and radical lengths decreased significantly by increasing concentration of aqueous cabbage extracts. The same results obtained in laboratory experiments more or less agree with that obtained with field experiments. These results suggest that brassica residues are capable of delaying seedling emergence and reducing establishment of wild oat, wild mustard and nettle-leaved goosefoot wild grass.

The results also demonstrated that, 8% cabbage root extract completely inhibit the germination of wild oat seeds. Meanwhile application of 6%, 4% and 2% aqueous cabbage root extract, yielding in 90%, 72% and 44% reduction in the germination of wild oat seeds respectively.

Chenopodium seeds are sensitive to allelopathic effects of cabbage root aqueous extracts. Maximum reduction in germination occurred with 8% concentration. At concentrations of 6% and 4 %; the germination was reduced to about 62% and 47% respectively. However, 2% concentration resulting in reduction of 40% of chenopodium seeds germination. All of the above results were in comparison with that distilled water control.

The current study indicated that, there was a negative linear regression between cabbage leave extract concentration and germination percentage for all three tested wild grasses seeds, Wild oat is the more sensitive to the allelopathic effect of cabbage leaves extracts, it reach to zero germination percentage at 6% concentration. and Wild Mustard reaches at 8% but Chenopodium reaches at 10.9% concentration, also illustrate the effect of cabbage leaves extracts on germination of wild mustard seeds. Zero germination percentage obtained when 8% aqueous cabbage leaves extract used. Mean while, the use of 6%, 4% and 2% cabbage leaves extract leads to 20%, 22% and 39% germination percentage respectively.

**المستخلص**

كان واضحا أن الإنبات النهائي وأطوال الرويشة والجدير انخفضت بشكل ملحوظ مع زيادة تركيز مستخلصات الملفوف المائي. نفس النتائج تم الحصول عليها في التجارب المعملية أكثر أو أقل توافقا مع ما تم الحصول عليها مع التجارب الحقلية. هذه النتائج تشير إلى أن مستخلصات الملفوف (الكرنب) قادرة على تأخير ظهور البادرات وتقليل إنبات الشوفان البري (wild oat)، والخردل البري (wild mustard) ونبات العفينة (chenopodium).

وأظهرت النتائج أيضا أن 8٪ مستخلص جذور الملفوف تمنع تماما إنبات بذور الشوفان البري. وفي الوقت

نفسه تراكيز 6٪ ، 4٪ و 2٪ مستخلص مائي جذور الملفوف يخفض 90٪ ، 72٪ ، 44٪ في إنبات بذور الشوفان البري على التوالي. أن بذور chenopodium حساسة لتأثير مستخلصات جذر الملفوف المائي. حدث الحد الأقصى في الإنبات مع تركيز 8٪. مع أن تركيزات 6٪ ، 4٪ و 2٪ انخفض الإنبات إلى 62٪ ، 47٪ و 40٪ على التوالي. وكانت كل من النتائج المذكورة أعلاه بالمقارنة بالماء المقطر. إن الدراسة الحالية تشير إلى أن هناك انحدار سلبي بين خطي تركيز مستخلص أوراق الملفوف المائي والإنبات للبذور الثلاثة المختبرة للأعشاب البرية، الشوفان البري هو أكثر حساسية لتأثير التضاد لمستخلصات أوراق الملفوف، فإنه يصل إلى إنبات صفر٪ عند تركيز 6٪. والخردل البري يصل إلى الصفر في تركيز 8٪. ولكن نبات chenopodium يصل إلى الصفر في تركيز 10.9٪. في حين تراكيز 6٪ ، 4٪ و 2٪ لمستخلصات أوراق الملفوف تكون نسبة إنبات بدور الخردل البري 20٪ ، 22٪ و 39٪ على التوالي.

**Introduction:**

The phenomenon of plants influencing neighboring plants through the release of chemicals in the environment has been known as early as 370 BC. Greeks and Romans have used this knowledge in agriculture. However, it was not until 1937 when Hans Molisch gave it a formal name, allelopathy. The definition of allelopathy ranges from simple to all-inclusive and complex, creating controversy as to its limits and bounds. The complexity and interacting nature of the allelopathy phenomenon makes it difficult to demonstrate its role in community organization (Ren Sen Zeng. *et al*.2008).

Allelopathy is a term introduced by Molisch (1937) and has been defined as the influence of one plant upon another growing in its vicinity by the release of certain metabolic toxic products in the environment (Levitt. *et al.* 1981).

Many noxious annual and perennial weeds have been regarded as species with allelopathic potential and can severely affect crop survival and productivity. Allelochemicals produced by plants may be released into the surrounding environment in sufficient amounts with enough persistence to affect neighboring and succession species. (Qasem. 2001).

The allelopathic potential of certain weed and crop species can influence the growth and distribution of associated weed species and the yield of desired plants, and allelopathy has been employed successfully in biocontrol programs focusing on control of problematic weeds and plant diseases. To exploit allelopathy both for crop improvement and for development of a more sustainable agriculture, including weed control, cover crops, pest management through crop rotation, nutrient enrichment, and residue management.

Because of an increased understanding of allelopathy, it is clear that allelopathy can help in the progress toward a more sustainable agriculture worldwide (Inderjit & Keating. 1999).

The objective of the current study is to effect the allelopathic potential of different parts of cabbage plant ( *Brassica oleracea* L. var. capitata); on germination and growth of some widely distributed weeds in Ghaneema area – Libya. The three most common weeds tested in the present study were, wild oat (*Avena fatua* L.), Nettle-leaved

Goosefoot (*Chenopodium murale* L.) and wild mustard (*Brassica tournefortii* Gouan.

It is difficult to demonstrate allelopathy in nature due to the complex interrelations between the different plants. Proving allelopathy also requires a cause-and-effect relationship between identifiable exuded chemical compounds and their effects on growth of plants.

Methodological concerns have been the major obstacle in the study of allelopathy. However, this is becoming easier to overcome with our increasing understanding of the chemical processes occurring in both natural and managed ecosystems and with our ability to identify allelochemicals. Progress in chemistry, biotechnology and digital technology as well as an increased understanding of ecological processes help explain the rapid progress in allelopathy research over the last four decades.

Qasem (2001); found that the effect of white top (*Cardaria draba*) and Syrian sage (*Salvia syriaca*) were toxic to different crops under laboratory conditions, with most effects on tomato and cabbage. In pot experiments, surface-placed shoot residues of studied weed significantly delayed seed germination and reduced seedling growth of all crops used. Carrot, onion, and tomato being the most affected. Decayed residues of white top were also toxic, lower toxicity was obtained when fresh materials were used. Foliage leachates or root exudates of both weed species added or released into the soil mixture reduced seedling growth of cabbage and tomato. Results showed that white top and Syrian sage are of great allelopathic potential against different vegetable crops; cabbage, onion, and tomato being the most sensitive crops.

. Qasem and Abu-Irmaileh (1985) investigated the allelopathic effect of Syrian sage (*Salvia syriaca*) on wheat. This weed was examined against wheat in glasshouse and laboratory experiments. Germination of wheat grains is delayed, and the development of wheat seedlings is decreased in laboratory experiments by both shoot and rhizome extract. Shoot extracts had more drastic effects than rhizome extract on germination percentage, shoot and root lengths. In glasshouse experiments fresh and dried shoot of syrian sage added to soil drastically decreased germination and development of wheat. It was found that cucumber markedly reduced the stand of barnyard grass and redroot pigweed. The stand of barnyard grass was reduced about 80% and redroot pigweed about 60% by cucumber.

Dhima. *et.al* (2006); conducted a study to measure the effect of two barley (*Hordeum vulgar* L.) and six triticale (xTriticosecale) cultivars and three rye (*Secale cereal* L.) populations, used as cover crops, on the emergence and growth of barnyard grass (*Echinochloa crus-galli* L. P. Beauv.), bristly foxtail (*Setaria verticillata* L. P. Beauv.), large crabgrass (*Digitaria sanguinalis* L. Scop.), and sugar beet (*Beta vulgaris* subsp. vulgaris). Also, bioassay studies they conducted to assess allelopathic potential of the winter cereal extracts on large crabgrass and sugar beet. Large crabgrass and sugar beet growth were reduced more by rye extracts than by triticale or barley. These results suggest that barley and rye could be used as cover crops for annual grass weed in sugar beet. Dhima, *et.al* (2006) all winter cereal extracts reduced barnyard grass and bristly foxtail seed germination and seedling, but none of them had any effect on corn. Bristly foxtail was affected more by all extracts than barnyard grass, and growth of both weed species was reduced more by the extract of barley. this study suggest that some winter cereals such as barley cultivar could be used as cover crop for annual grass weed suppression in corn and consequently to minimize herbicide applications. Dhima, et.al (2006). Found that some winter cereals have the ability to suppress seed germination of annual grass weeds and in combination with inter-row cultivation could increase cotton yield. However, herbicide usage is essential to maximize cotton yield and consequently to satisfy cotton producers.

Chung. *et.al*. (2003) used rice (*Oryza sativa*) as allelopathy for weed control which is a new technology in agronomy. Their results suggest that rice body parts may be a source of natural herbicides and that it is necessary to develop acceptable selection standards. There may also be genetic variation in rice varieties for their allelopathic potential on barnyard grass. In the future, it might be possible to develop rice varieties with high allelopathic potential. Bell and Nalewaja.(1968) found that wild oat (*Avena fatua* L)at densities of 84 and 191 plants per square meter reduced wheat (*Triticum aestivum* L ) seed yield by 22 and 39%and barley ( *Hordeum vulgare* L.) seed yield by 7 and 26% respectively.

Arslan, *et.al* (2005); found that the allelopathy potential of shoot powder extracts of some Brassica species, white radish (*Raphanus sativus* L. var. longipinnatus), garden radish (*Raphanus sativus* L.var. radicula), black radish (*Raphanus sativus* L. var. niger),little radish (*Raphanus sativus* L. var. sativus), turnip ( *Brassica camestris* L.) and rapeseed (*Brassica naps* ) on seed germination and seedling growth of Cut leaf Ground-Cherry (*Physalis angulata* L.) Allelopathic effects of shoot powder extracts of six Brassica species at various concentrations on cut leaf ground –cherry. Shoot powder extracts of Brassica species exhibited marked differences in the inhibition of cut leaf ground-cherry seed germination and seedling growth. Inhibition on seedling growth was not as much as inhibition on seed germination. The inhibitory effects of shoot powder extracts on cut leaf ground-cherry seed germination is increased as the concentration increased. These results imply that Brassica species have great potential for cut leaf ground- cherry control. Arslan, et.al. (2009) investigated the allelopathy potential of residues of some Brassica species, which are round white radish (*Raphanus sativus* L. var. longipinnatus), garden radish (*Raphanus sativus* L. var. radicula), black radish (*Raphanus sativus* L. var. niger), little radish (*Raphanus sativus* L), turnip (*Brassica camestris* L.) and rapeseed (*Brassica naps*) on Johnson grass. All species suppressed Johnson grass plant growth. The lowest suppression was found from garden radish. The higher amount of isothiocyanate in black radish extract was determined. Parallel results for Johnson grass suppression and amount of isothiocyanate showed that allelopathy play roles in Johnson grass suppression by Brassica species.

Tabbache, *et.al* (2008) carried a study to examine the effect of some Brassicas residues (Cabbage, Radish, and Kohlrabi), using water extracts and dry powder in three concentrations: 1.25, 2.5, 5% on the growth and germination of plants (Wheat, Radish, Cress, Chicory). The results revealed that cabbage extract in 5% was most effective on plants germination (80, 76.7, 53.3, 80%) in succession, and on the stem growth (5.45, 4.1, 4.7, 0.87 Cm) in succession, and on the root growth (3.12, 1.38, 1.05, 0.33 Cm) in succession. On the other hand, using cabbage dry powder in 5% affected plants growth and the lengths were (23, 10.1, 7.62, 2.28 Cm) in succession. Also, using cabbage dry powder and kohlrabi dry powder in 5% was most effective on plants wet weight In general; cress and chicory plants were most sensitive to the effect of Brassicas water extracts and dry powder used in study.

Vasilakoglou, *et.al* (2010) study was conducted to assess nitrogen supply effect on the ability of four canola hybrids to compete with corn poppy (*Papaver rhoeas* L.) as well as its effect on canola seed and oil yields. Phytotoxic potential of canola hybrids on germination and growth of winter wild oat (*Avena sterilis* spp. *ludoviciana* L.), corn poppy, and wild mustard (*Sinapis arvensis* L.) was also determined using a perlite-based bioassay. At canola blossom, corn poppy plant number in nitrogen-treated plots was 23% less than that in the nitrogen-untreated ones. Canola seed and oil yield was reduced 18.6 and 23.7%, respectively, by the competition of 100 corn poppy plants $m^{-2}$, with 'Elan' and 'Titan' the most productive hybrids. Nitrogen supply did not increase in all cases the competitive ability or the seed and oil yields. In the laboratory, germination of the winter weeds was completely inhibited by the greatest extract concentration (5 g 100 $mL^{-1}$) of all hybrids. Nitrogen supply did not affect, in most cases, the phytotoxicity of canola hybrids, while phytotoxicity did not significantly differ among hybrids.

Murimwa *et .al. ,* (2019) Laboratory enzyme assays were conducted using different sorghum aqueous leaf and stem extract concentrations at 0, 2.5, 5.0, 7.5, and 10.0% wv−1 to determine the effect of sorghum aqueous extracts on plant defense enzymes polyphenol oxidase (PPO), peroxidase (POD), and phenylalanine ammonia lyase (PAL) in sesame and selected weeds. Greenhouse experiments were conducted to assess the effect of sorgaab or sorgaab-Agil postemergence sprays on the seedling growth and physiology of sesame and weeds. The exposure of sesame, black jack, and goose grass to sorghum aqueous extracts caused a significant concentration-dependent increase on the activity of antioxidant enzymes PAL, POD, and POD. Similarly, postemergence sprays of sole sorgaab, herbicide, and sorgaab-herbicide combination significantly () increased sesame and black jack seedling growth, chlorophyll content, and fluorescence but not of goose grass. From this study, it could be concluded that the allelochemicals in sorghum aqueous extracts were not effective at inhibiting the growth and physiological processes of sesame and the weeds. Therefore, resource-poor farmers cannot rely on sorgaab to control weeds in sesame but there is a need to integrate weed control options to form an effective integrated weed management program.

Scavo *et.al.* (2018) It is known that the presence of weeds causes serious losses to the agricultural production, both in quantitative and qualitative terms. The major problem in modern agriculture is the environmental impact of synthetic herbicides and the increase in herbicide- resistant weed species. Allelopathic compounds can be used to develop a sustainable weed management system based on natural products. The objective of this study was to evaluate the allelopathic potential of leaf aqueous extracts (40 and 80%) obtained from *Cynara cardunculus* L. plant species on seed germination and mean germination time of six common weeds in Mediterranean agroecosystems: *Amaranthus retroflexus* L., *Diplotaxis erucoides* (L.) DC., *Portulaca oleracea* L., *Lavatera arborea* L., *Brassica campestris* L. and *Solanum nigrum* L. Effects varied with the weed species and the concentrations of the extracts. On average, the aqueous leaf extracts significantly reduced the final percentage of seed germination compared to the control for *A. retroflexus* (–58.1%), *D. erucoides* (–43.9%) and *P. oleracea* (–42.5%). The rate of germination decreased with increasing extract concentration. In *C. cardunculus* L. var. *sylvestris* the autoallelopathic activity also was demonstrated. These results are very promising in order to produce a bioherbicide based on *C. cardunculus* allelochemicals.

Suleyman *et.al*.(2019) The purpose of this study is to determine the allelopathic effects of extracts obtained by using liquid nitrogen from the plant of Antep radish (Raphanus sa-tivus L.) and little radish (Raphanus sativus L. var. radikula) on germination and seedling growth of sterile oats. The experiments were carried out in six groups with root, stem and root stem mixed extracts of radish plants (Antep and little radish). A novel method that we developed based on the principle of liquid nitrogen crushing was used for extraction. According to this method, Antep radish and little radish plant parts were frozen with liquid nitrogen aid and then crushed to powder. These powders obtained were stored at ？20？C for nine months until the experiments were established. The aqueous solutions prepared at specific concentrations (0%, 1%, 2%, 4%, 8%, 16%) from the ob-tained radish powders were applied as 5 ml to per each petri dishes contain 10 seeds on Whatman No: 1 double layer filter paper. Experiments were carried out in six replicates for each concentration. The prepared petri dishes were kept in the incubator at 15？C for 15 days. At the end of the experimental period, the number of germination of the seeds of sterile wild oat plant was evaluated by measuring the length of seedling root and stem. As a result, as the concentra-tion of allelopathic solutions increased in all experimental groups, the number of germination and root and stem lengths of sterile wild oats decreased. Alt-hough allelopathic effects in all three experimental groups were observed in terms of germination number and seedling lengths, the most significant effects were observed in the results of Antep radish root experiments. In this experi-ment group, the inhibition rate of root and stem length of weed seeds at a con-centration of 16% were 86% and 82%, respectively, when compared to the control. In addition, the germination number was reduced by 74.36% in the seeds at the highest concentration compared to the control. As a result of the study, it was determined that samples of radish plant crushed with liquid nitro-gen were stored for a long time and showed high allelopathic effect on sterile wild oats plant.

## Research aims

The objective of the current study is to evaluate the allelopathic potential of different parts of cabbage plant (*Brassica oleracea* L. var. capitata); on germination and seedling growth of wild oat (*Avena fatua* L.), Nettle-leaved Goosefoot (*Chenopodium murale* L.) and wild mustard (*Brassica tournefortii* Gouan which are widely distributed in Ghaneema area – Libya.

**Material and Methods**

This study was carried out at the Botany Laboratory at the Faculty of Arts and Sciences, Qasr Al-Akhyar, located at area (70 kilometer east of Tripoli),. during the period 2019-2020.

1. Potentially allelopathic plant:

Cabbage (*Brassica oleracea*), was collected from Qasr Al-Akhyar; Libya. Cabbage plants were collected in full flowering stage, harvesting the heads of the plant and collecting leaves and roots. Roots and leaves were cleaned very well from soil by washing with tap water and disinfected in 2.5% bleach for 15 min, then rinsed with distilled water. The leaves and roots were divided into small pieces, dried in oven at 70°C for 48 hours. All samples were separately ground to fine powder to pass through a 1-mm sieve.

2- Test material (Indicator species):

Grass seeds of wild oat (*Avena fatua* L. Family Poaeceae), nettle-leaved goosefoot (*Chenopodium murale* L. Family chenopodiaceae ) and wild mustard (*Brassica tournefortii* Gouan, Family Brassicaceae); were collected from farms located in the above mentioned area during 2019 autumn season.

Seeds used in this study were uniform in size. Small size seeds and apparently unhealthy seeds were excluded. Seeds were subjected to surface sterilization using 0.1% mercuric chloride for 1 minute in order to eradicate fungal spores if any. Then washed with distilled water, for several times to remove the residual mercuric chloride. Finally seeds were placed on filter papers at room temperature and left for a sufficient time in shade until completely dried. The dried seeds were stored in dry vials until being used.

Methods: **Laboratory experiments**:

a) Experiment 1. Plant sampling and preparation of extracts:

Aqueous extracts (w/v) were prepared from powdered plant parts in 400-ml. glass jars. Concentrations of extracts were prepared; 0 (distilled water), 4, 8, 12 and 16 g powder in 400 ml glass jars. The total volume is then completed to 200 ml. with distilled water. The mixture was subjected to continuous shaking for 3 h at 200 rpm. Finally the extracts were filtered separately through a double layer of cheese cloth, followed by two layers of Whatman no. 1 filter paper to remove fiber debris. The final purified extracts (2%, 4%, 6% and 8%) considered as stock solutions and were kept in a refrigerator at 4°C until further use (bioassay).

b) Experiment 2. Germination Tests:

Germination test of pretreated seeds of the tested wild oat, nettle-leaved goosefoot and wild mustard were performed in sterilized Petri dishes (15-cm diam.). Twenty five uniform seeds of the test species were kept for germination in sterilized 15 cm Petri dishes containing two layers of filter paper (Whatman No. 1). The Petri dishes were maintained in an incubator (at 24 ± 1°C) for 7 days. Samples were moistened with 6 cm of different concentrations of extracts separately. Equal volume of distilled water was added in the dishes when moisture content of the filter paper declined. The experimental design was randomized complete block design with four replications. Control is achieved by doing the same steps, except that only extract was substituted with distilled water. at the end of the test period germination percentage was determined by counting the number of germinated seeds (radical length >2 mm) after 7 days. (Qasem. 2001).

**Results and discussion**

Herbicide resistance in weeds is rapidly expanding phenomenon around the world resulting in higher costs of production and greater weed impact. With current pressures to reduce herbicide usage but maintain cost-effective weed control, the innate ability of crops or cultivars to suppress weed growth has become increasingly important. The increasing appearance of herbicide-resistant weeds in the fields may force breeders to consider breeding for competitiveness as a high priority. Moreover, knowledge of competitive ability of weeds is desirable for development of economically and environmentally acceptable weed management systems.

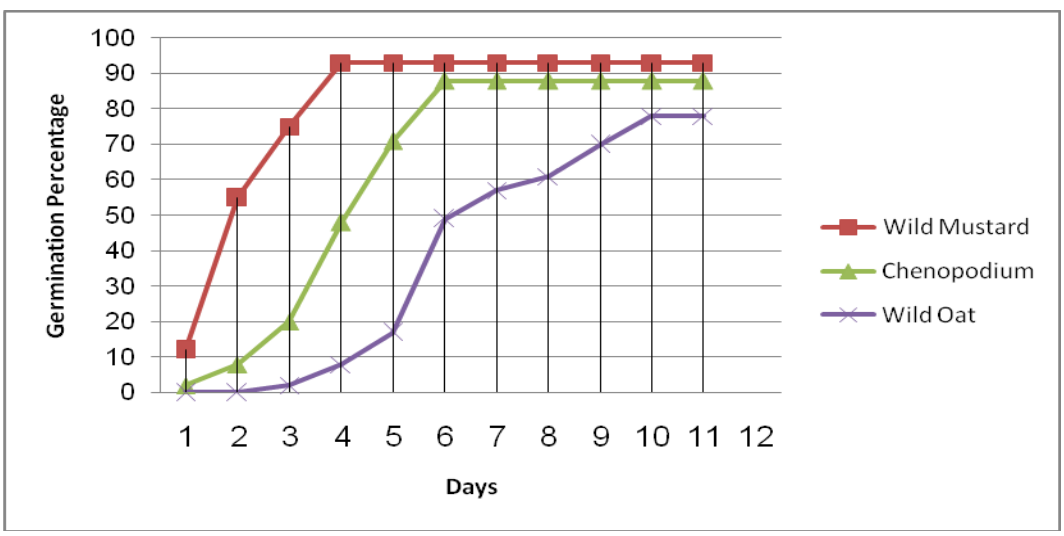
It is well established that weed species vary in their competitive effects on crops. Effective weed control management has been dependent upon farmers gaining knowledge of the characteristics of the weeds they were managing.

The Brassicaceae contain glucosinolates, which hydrolyze to form compounds toxic to plants, fungi, nematodes, and certain insects. Lower weed density and biomass in crops grown following incorporation of brassica cover crops suggest that they may contribute to weed management in agricultural systems including wild oat, wild mustard, and chenopodium.

The primary focus of this research was to test the allelopathic effects of cabbage dried leaves and root residues, green cabbage leaves as well as cabbage leaves and root extracts on germination and growth of wild oat, wild mustard and nettle-leaved goosefoot wild grass.

**Results of laboratory experiments:**
**I.A. Germination tests:**
**I. A.1-Control:**

Preliminary study results indicated that wild mustard, chenopodium and wild oat reached the highest germination percentage after 4, 6 and 10 days respectively. The final germination percentages of wild mustard, chenopodium and wild oat were 93%, 88% and 78% respectively; Figure (A.1).




Figure(1): Germination percentage of wild mustard, chenopodium and wild oat at 24°C.

**I.A.2-Effect of cabbage root extract on germination:**

Figure (A.2) illustrate the effects of adding cabbage root extracts on the rate of seed germination of all tested wild grasses. The results clearly proved that the germination percentage is clearly different in presence of cabbage root extracts as compared with that of control. The germination percentage in case of control was higher than that of other treatments with cabbage root extracts.

Concerning the competitive relationships of cabbage root extract and wild mustard; the results demonstrated that aqueous extract powdered root of cabbage had an inhibitory effect on wild mustard seed germination in all extract concentrations used. Maximum reduction in the germination percentage of wild mustard seeds (80 %) occurred on using 8% extract concentration. However using 6% extract concentration; resulting in 38% reduction of wild mustard seed germination percentage.

The results also demonstrated that, 8% cabbage root extract completely inhibit the germination of wild oat seeds. Mean while application of 6%, 4% and 2% aqueous cabbage root extract, yielding in 90%, 72% and 44% reduction in the germination of wild oat seeds respectively. The results demonstrated that Chenopodium seeds are sensitive to allelopathic effects of cabbage root aqueous extracts. Maximum reduction in germination occurred with 8% concentration. At concentrations of 6% and 4 %; the germination was reduced to about 62% and 47% respectively. However, 2% concentration resulting in reduction of 40% of chenopodium seeds germination. All of the above results were in comparison with that of control. It is noteworthy that decrease in germination percentage led to a delayed emergence of all three plants seedlings. but the study of (Tabbache, *et.al*) at the university of Tishreen - Syria on laboratory experiments for cabbage extract, which was the most influential of the antagonism of other plants used at a concentration of 5% with different types of wild plants used in Tabbache study. As well as the impact of dry cabbage on those plants used results were almost compatible. carried a study to examine the effect of some Brassica residues (Cabbage, Radish, and Kohlrabi), using water extracts and dry powder in three concentrations: 1.25, 2.5, 5% on the growth and germination of plants (Wheat, Radish, Cress, Chicory). The results revealed that cabbage extract in 5% was most effective on plants germination (80, 76.7, 53.3, 80%) in succession.

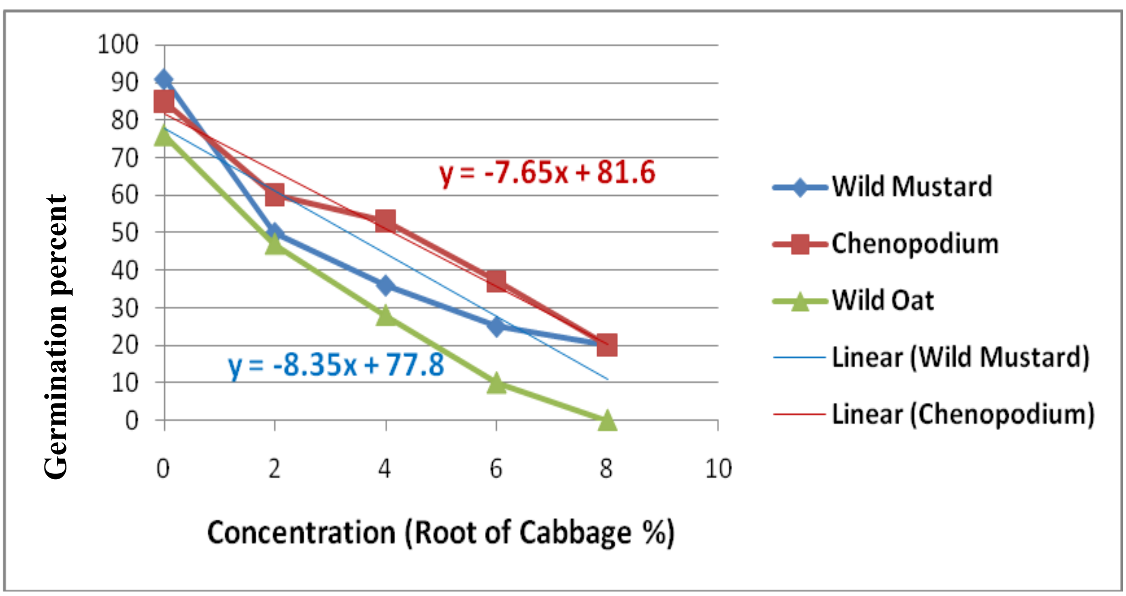



Figure 2. Effects of different concentrations of Cabbage root extract on seed germination

of tested seeds

Table (1) Model Summary and Parameter Estimates for Chenopodium

Dependent Variable: Germination %

| Parameter Estimates | | Model Summary | | | | Equation |
|---|---|---|---|---|---|---|
| b1 | Constant | Sig. | F | R | R Square | |
| - 7.65 | 81.6 | 0.002 | 122.99 | 0.976 | 0.988 | Linear |

The independent variable is Concentration (Root of Cabbage).

Table (1) shows that the regression is significant (p= 0.002) which means that the independent variable (Concentration) can significantly predict the dependent variables (Germination %), the $R^2$ value indicates that only 98.8% of the variance in the dependent variable is explained by the independent variable.

$$y= 81.6 – 7.65 x$$

Table (2) Model Summary and Parameter Estimates for Wild Mustard

Dependent Variable: Germination %

| Parameter Estimates | | Model Summary | | | | Equation |
|---|---|---|---|---|---|---|
| b1 | Constant | Sig. | F | R | R Square | |
| - 8.35 | 77.8 | 0.023 | 18.34 | 0.927 | 0.859 | Linear |

The independent variable is Concentration (Root of Cabbage).

Table (2) shows that the regression is significant (p = 0.023) which means that the independent variable (Concentration) can significantly predict the dependent variables (Germination %), the $R^2$ value indicates that only 85.9% of the variance in the dependent variable is explained by the independent variable.

$$y= 77.8 – 8.35 x$$

**I.A.3-Effect of cabbage leave extract on germination:**

The results of the current study indicated that, there was a negative linear regression between cabbage leave extract concentration and germination % for all three tested wild grasses seeds, Figure(3).

Wild oat is the more sensitive one to the allelopathic effect of cabbage leaves extracts, it reach to zero germination % at 6% concentration. and Wild Mustard reaches at 8% but Chenopodium reaches at 10.9% concentration, also illustrate the effect of cabbage leaves extracts on germination of wild mustard seeds. Zero germination % obtained when 8% aqueous cabbage leaves extract used. Mean while, the use of 6%, 4% and 2% cabbage leaves extract leads to 20%, 22% and 38% of what respectively.

Chenopodium is the least one of the three tested wild grasses seeds affected by cabbage leaves extracts used. The highest reduction in germination 75% obtained when 8% cabbage leaves extracts used. However, 67%, 63% and 60% reduction in germination resulted from using 6%, 4% and 2% cabbage leaves extracts, Figure(3).

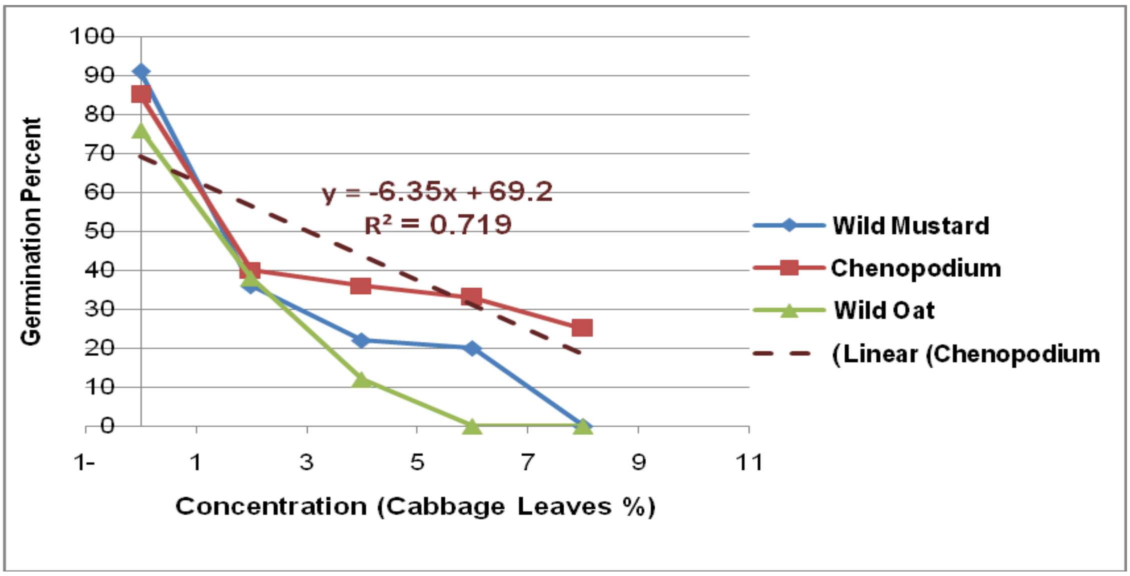



Figure 3. Effects of different concentrations of Cabbage leaves extract

on seed germination of tested seeds.

Table (3) Model Summary and Parameter Estimates for Chenopodium

Dependent Variable: Germination %

| Parameter Estimates | | Model Summary | | | | Equation |
|---|---|---|---|---|---|---|
| b1 | Constant | Sig. | F | R | R Square | |
| - 6.35 | 69.2 | 0.06 | 7.68 | 0.848 | 0.719 | Linear |

The independent variable is Concentration (Root of Cabbage).

Table (3) shows that the regression is no significant (p = 0.06) which means that the independent variable (Concentration) can't significantly predict the dependent variables

(Germination %), the $R^2$ value indicates that only 71.9% of the variance in the dependent variable is explained by the independent variable.

y= 69.2 – 6.35x

**I.A.4-Effect of cabbage root extracts on radical lengths:**

The allelopathic effects of aqueous cabbage root extracts on radical length of the three tested wild grasses were presented in Figure (4). Wild oat is the more sensitive one to the allelopathic effect of cabbage root extracts, it reach to zero centimeter at 8% concentration. Other cabbage root extracts, 6%, 4% and 2% reduces the radical length of wild oat to 2.8, 3.0 and 3.3 centimeters respectively.

Wild mustard is the second one affected by cabbage root extracts. The radical length is reduced to 0.4, 0.6, 2.1 and 3.0 centimeters, on application of 8%,6%, 4% and 2% cabbage root extracts respectively.

Chenopodium is the least one of the three tested wild grasses affected by cabbage root extracts used. The highest reduction in radical length (1.2 centimeter) obtained when 8% cabbage root extracts used. However, 1.3, 1.5 and 1.5 centimeters of obtained from using 6%, 4% and 2% cabbage root extracts.

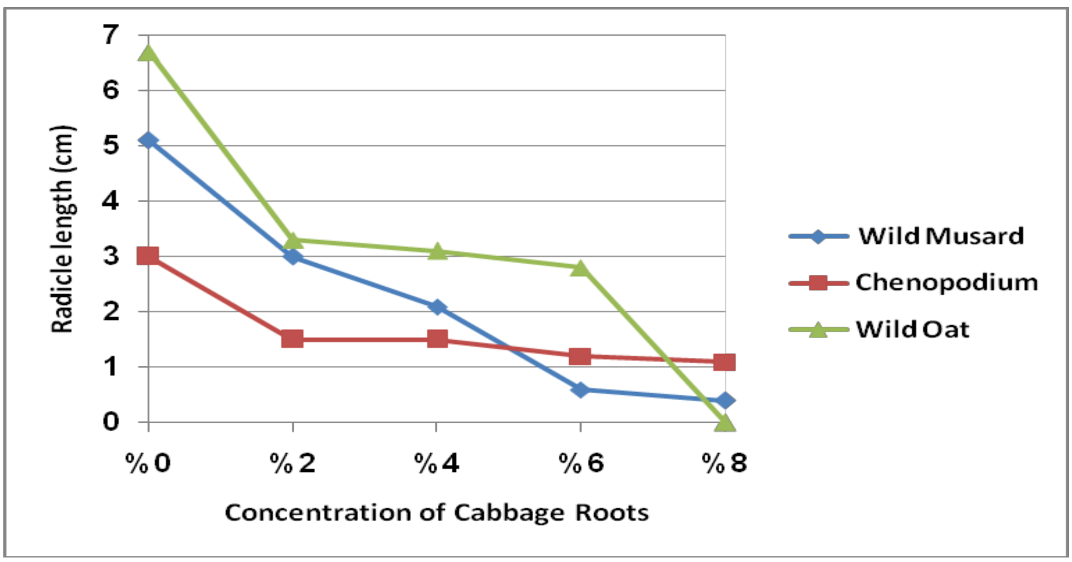



Figure 4. Effects of different concentrations of Cabbage roots extract on radical length of tested seeds.

**I.A.5-Effect of cabbage leave extracts on radical lengths:**

The allelopathic effects aqueous cabbage leaves extract on radical length of the three tested wild grasses were more potent in reducing the radical lengths as showed in figure (5). The radical lengths of all three plants reach to zero centimeter at 8% concentration aqueous cabbage leaves extract. Also zero centimeter radical length of wild oat occurred with 6% concentration aqueous cabbage leaves extract, while 6% concentration aqueous cabbage leaves extract reduces radical lengths of wild mustard and chenopodium to about 0.3 and 0.6 centimeters respectively.

The effects of other concentrations of aqueous cabbage leaves extract on radical lengths of wild mustard were as follow; 1.75 centimeters was obtained with 4% concentration and 2.6 centimeters was obtained with 2% concentration.

Chenopodium was also affected by other concentrations of cabbage leaves extract, but to lesser extent than the other two grasses; where 4% and 2% extracts resulting in 0.8 and 2.3 centimeters radical lengths respectively (figure 5).

All of the above results compared with that of the control, where the radical lengths of wild oat (6.8 centimeters), wild mustard (5.1 centimeters) and chenopodium (3.0 centimeters).

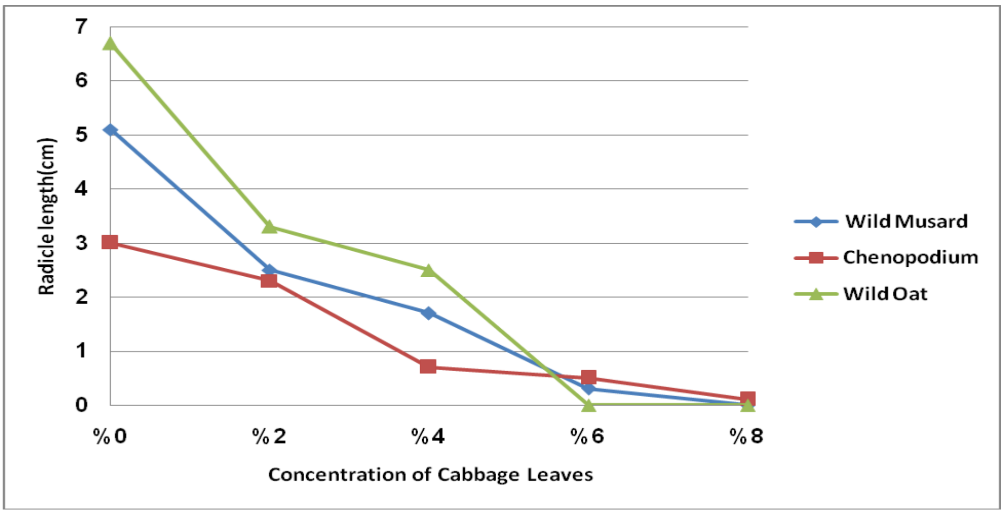



Figure 5. Effects of different concentrations of Cabbage leaves extract on radical length of tested seeds.

**I.A.6-Effect of cabbage leave extracts on plumule lengths:**

Figures (6 & 7) represent the allelopathic effects of aqueous cabbage root and leaves extracts on plumule lengths of the three tested wild grasses.

The competitive effects of aqueous cabbage root & leaves extracts on plumule lengths of wild oat is presented in figures 6 & 7 and the results indicated that, 8% root extract & 8% & 6% leaves extract concentrations capable to reduce plumule length to zero centimeter. The same also was observed for wild mustard on using 8% leaves extract. However, 8% root extract inhibit wild mustard plumule length to 1.0 centimeter.

Other root extract concentrations, 6%, 4% and 2% reduces plumule lengths of wild oat to 4, 5 and 8 centimeter respectively, compared with that of control (12 centimeters).

It was clear from the results presented in figures 6 & 7, that the inhibitory effects of cabbage root extracts is less than inhibitory effects of cabbage leave extracts on plumule lengths of wild mustard. The use of 2%, 4% and 6% of cabbage root extracts reduce plumule lengths of wild mustard to 4.0, 3.2 and 1.3 centimeters respectively. In the meantime the effects of other concentrations of aqueous cabbage leaves extract on plumule lengths of wild mustard were as follow; 0.9 centimeter was obtained with 6%

concentration, 3.2 centimeters was obtained with 4% concentration and 4.7 centimeters was obtained with 2% concentration, compared with that of control (7 centimeter).

Chenopodium plumule lengths also affected adversely by application of aqueous cabbage root & leaves extracts as showed in figures 6 & 7 in the same manner as that the case of the adverse effect on radical lengths. Chenopodium plumule lengths was reduced to1.8, 2.0, 3.7 and 4.4 centimeters by the use of 8%, 6%, 4% and 2% cabbage root extracts respectively, as compared with that of control (7.2 centimeters).

Aqueous cabbage leaves extracts, is more effective in controlling chenopodium plumule lengths, than cabbage root extracts. Chenopodium plumule lengths was reduced to 0.8, 2.0, 2.8 and 4.2 centimeters by the use of 8%, 6%, 4% and 2% cabbage leave extracts respectively, as compared with that of control (7.1 centimeters).

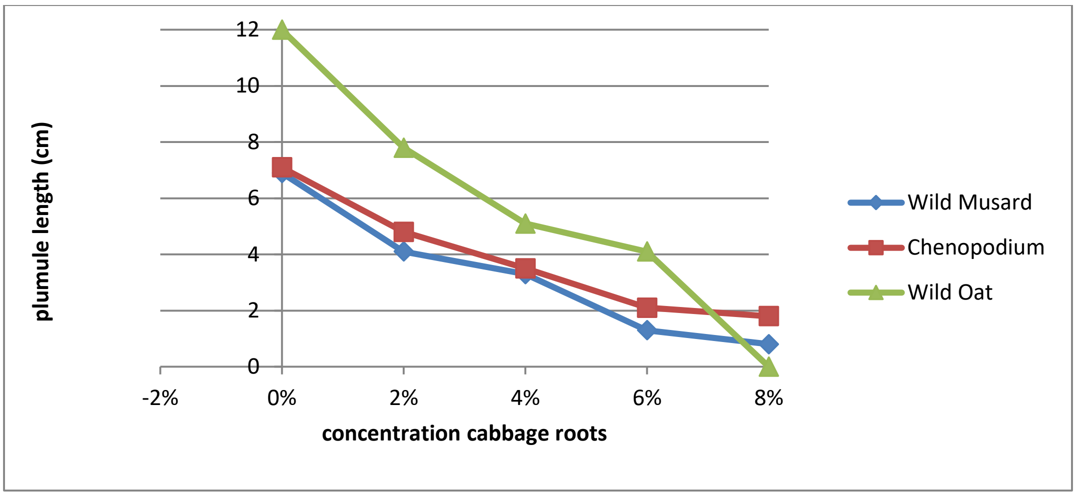



Figure 6. Effects of different concentrations of Cabbage roots extract on Plumule lengths of tested seeds.

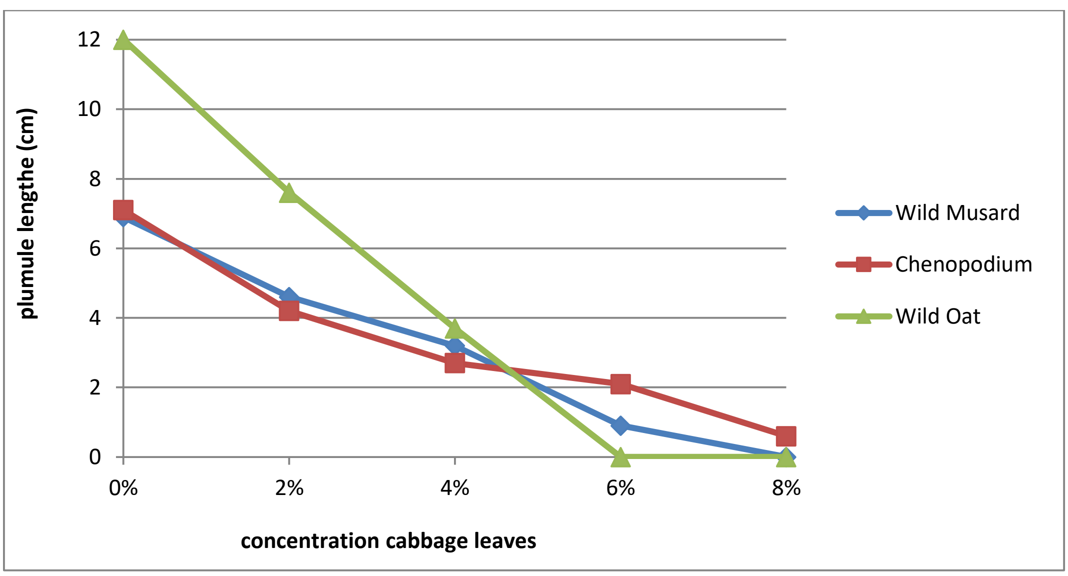



Figure 7. Effects of different concentrations of Cabbage leaves extract on plumule lengths of tested seeds

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