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# Influence of Aqueous and Ethanol Extracts of *Tamarix articulata* and *Ziziphus spina-christi* L. Trees Leaves on the Growth, Yield and its Quality of Pea Plant

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**Abstract:** Two field experiments were conducted during the two successive seasons of 2016/2017 and 2017/2018 in clay soil under drip irrigation system at the Experimental Farm, Kaha station, Qulubia Governorate to study the effect of using three extraction methods (cold aqueous extract, hot aqueous extract in addition ethanolic extract) and five extract sources, i.e. water (as control), fresh leaves of *Tamarix articulata*, fresh leaves of *Ziziphus spina-christi* L., dry leaves of *Tamarix articulata* and dry leaves of *Ziziphus spina-christi* L. as foliar spray on pea plants and the effect of that on growth, chemical characters and the pod yield of pea cv. Entsar1. The results indicated that, in general, the highest values of vegetative growth (plant length, number of leaves/plant, number of branches/plant and dry weight of shoots /plant) as well as the green pods yield and its characters i.e., pod length, pod diameter, number of seeds/pod, pod fresh weight, fresh weight of 100 seed as well as some chemicals properties of pea seeds i.e., N, P, K, total protein, total sugar and total phenol were obtained from treatments of foliar spray by cold or hot aqueous extract from dry leaves of *Tamarix articulata* and *Ziziphus spina-christi* L. trees in both growing seasons. Generally the obtained results revealed that the vegetative growth parameter, green pods yield and its components as well as some chemicals properties were increased when the pea plants sprayed by the different extracts source i.e., Tamarix or *Ziziphus* which its considered natural stimulation compounds comparing with the control (water) especially with foliar spray by hot aqueous extract from dry leaves of *Tamarix articulata* or *Ziziphus spina-christi* L. trees.

**Key words:** Pea · *Tamarix articulata* · *Ziziphus spina-christi* L. · Aqueous extract · Ethanolic extract · Growth · Yield

## INTRODUCTION

Pea (*Pisum sativum* L.) is a leguminous crop belonging to family leguminoseae, which characterize by contain higher amount of protein (21-25 %), carbohydrates, vitamins A and C, Ca, phosphorous and had high levels of amino acids lysine and tryptophan [1], hence it is consider excellent human food. Furthermore, this crop also plays a significant role in soil fertility restoration as a suitable rotation crop that fixes atmospheric nitrogen by contents from micro organisms. Also, the pea's crop area registries continues increment yearly in Egypt and this due to its high yield through short season with high stability price and often high economic competitiveness compared with the other cash winter crops.

It is noticed nowadays that, several plants extracts showed superior results as a natural nutrients feeding for the vegetable plants and considered more enhancing stimulation or protection the plants against the stresses than the mineral fertilizers. The wonderful information in this regard showed that, some kinds of plant extract had obvious results on enhancing growth and yield of some vegetable crops, whereas, these extracts contain many antioxidants such as phenolic compounds include phenolic acids, polyphenols and flavonoids. These compounds protect plants, fruits and vegetables from oxidative damage and used as antioxidants. Antioxidants are used to stimulate growth parameters and may be explained on basis that these substances encourage nutrient absorption, stimulate some growth activators synthesis, enhance plant cell growth and

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development in addition stimulate cell vacuolization and elongation as well as root growth factors that could positively affect plant growth, yield quantity and quality, stimulate nutrient absorption and NPK as mentioned by several investigators [2-7].

Regarding to using extract of (*Tamarix articulata*) (TARFA, Arabic and colloquial name) which it is a shrub or small tree with brown to blackish. It is distributed in the desert region as in Sinai, Egypt. It's also distributed in Syria, Jordan, Kuwait, Iran, West Pakistan and Libya. Literature survey on different *Tamarix articulata* species revealed a number of publications which mostly report the presence of phenolic and polyphenolic compounds, together with their esters and glycosides derivatives [8, 9]. Moreover, Sidr tree (*Ziziphus spina-christi* L.) commonly known as "Nebeq" in Egypt and Arabic countries it is a tree belonging to the genus *Zizyphus* in Rhamnaceae family, respectively. There are around 50 species of *Ziziphus spina-christi* L. tree distributed in tropical Asia, Africa and America. Several studies have indicated that *Ziziphus spina-christi* L. leaves contain phenolic and polyphenolic, flavonoids, tannins, sterols, saponins and triterpenoids. Furthermore, 11 different cyclopeptide alkaloids [10, 11].

Different extractions methods can be used to obtain plant extracts. The variety and extraction conditions used (type of solvent, concentration, time and temperature) can potentially affect the polyphenolic profile of the extracts and thus makes comparisons between studies difficult [12, 14]. Extraction processes of these metabolites play a significant and crucial role on the final result and outcome of any plant. However, extraction product not only depends on the extraction method but also on the solvent used for extraction. The qualitative and quantitative studies of bioactive compounds from plant materials mostly rely on the selection of proper extraction solvent. It was found that the previous studies have used methanol, petroleum ether, chloroform, ethanol, acetone and water as the solvents for extracting bioactive compounds from different plant species [15-17].

In this regard total phenolics were better extracted with hot water (90°C) than with cold water (25°C). Moreover, hot water (100°C for 3 min) extracted a higher phenolic content compared to cold water hibiscus extracts. The higher concentration of polyphenolic compounds differ than anthocyanins in hot water extracts which may have contributed to a higher antioxidant activity in these extracts as compared to cold water extracts. Also, the active components of spices might not dissolve completely in this solution before heating. After heating, the solubility of the active components probably increased because of decomposition of the cell wall and by passing of the solvent into the cell [18, 19, 12]. Also, Ramirez [20] indicated that, the dried hibiscus hot water sample had the highest concentration of total polyphenols followed by dried hibiscus cold water, fresh hibiscus cold water and fresh hibiscus hot water extracts. The hot water extracts of plants contain relatively higher amounts of high-molecular weight polysaccharides and lignin-carbohydrate complexes [21]. While Nagananda and statishandra [22] indicated that, the cold extracts were more effective than hot extracts because the bioactive component present in the extracts might be thermo labile which might lose its activity when extracted under heat. Moreover, Abdelfadel *et al*. [23] indicated that, hot extract led to increase the total phenolic compounds of thyme, cumin and cinnamon extracts.

The objective of this study was to compare between the effects of cold, hot water extraction and ethanolic extraction with fresh or dry leaves of *Tamarix articulata* or *Ziziphus spina-christi* L. trees as natural nutrient enhancement as well as a source of some stimulants on growth and yield of pea plants whereas this natural compounds considered antioxidant against to some stresses.

## MATERIALS AND METHODS

The experiment was conducted in the Experimental Farm, Kaha Station, Qalubia Governorate. The present work was carried out during two successive winter seasons of 2016/2017 and 2017/2018. The soil was clay in texture with 7 pH, 2.7 EC 1.2% organic matters, 103 ppm N, 50 ppm P and 89 ppm K. Seeds of pea cv. Entsar 1 were obtained from Horticultural Research Institute, Agriculture Research Center, Egypt and sown on November 15$^{nd}$ and 13$^{nd}$ in 2016 and 2017, respectively. The seeds were sown in hills on one side of irrigation ridge at 35 cm spaces between the hills, the area of each experimental plot was 2.4m$^2$ (4 m long with 0.6 m width). The other agricultural practices (irrigation, fertilization, weed control and pest control) for pea were carried out as the recommendation of ministry of agricultural.

The experiment was arranged in a split plot design with three replicates. It was include fifteen treatments, as shown in Table (1).

Table 1: Names of treatments used in this study

| Main plots | Sub plots |
|---|---|
| Extraction methods | Extract source |
| 1-Cold aqueous extract | 1-Water (control) |
| 2-Hot aqueous extract | 2-Fresh leaves of *Tamarix articulata* |
| 3-Ethanolic extract | 3-Fresh leaves of *Ziziphus spina-christi* L. |
| | 4-Dry leaves of *Tamarix articulata* |
| | 5-Dry leaves of *Ziziphus spina-christi* L. |

Table 2: The chemical components of *Tamarix articulate* and *Ziziphus spina-christi* L. leaves

| | Composition |
|---|---|
| Components of *Tamarix articulata* leaves taken from Tabet and Nouidjem [24]. | -Phenolic content (398.42 ± 5.21 mg /g DW)<br>-Total Antioxidant activity (345.92 ± 8.45mg /g DW)<br>-Total flavonoids (120.55 ± 3.41mg /g DW)<br>-Individual phenolic compounds (mg /g DW):<br>Gallic acid (2.574 ± 0.01), Vanillic acid (4.0907j ± 0.02),<br>Chlorogenic acid (5.791 ± 0.02), Caffeic acid (5.492 ± 0.01)<br>Tannins, Steroids, Terpenoids, (+) and Saponins (-) |
| Components of *Ziziphus spina-christi* L. taken from Saqur and Abbas [25]. | Water content (42.6%), Total ash (4.289%), Phenols (14.177%),<br>Total proteins (16.043%) and Saponins (2933.330µg /100g DW). |

Plants were sprayed three times with aqueous solution of the used materials; the first spray was conducted at the three true leaves stage, while the second and third sprays were preformed every10 days intervals.

**Preparation of Extracts:** The leaves of *Ziziphus spina-christi* L. and *Tamarix articulata* plants were collected from private horticulture farm at Luxor Governorate during 2016-2017 seasons. The leaves were cleaned from dust under running tap water then take part of its for fresh using and the another part of leaves were took for air-dried in the shade and finely powdered for dry using .After that the weight of 10 grams of fresh or dry leaves were taken and put into the electric mixer with one liter of cold water (cold aqueous extract), hot water (hot aqueous extract) and ethanol (98%) (ethanolic extract) then the leaves were soaked at 25°C for 24 hour, obtained extract re-filtered through No. 2 whatman filter paper.

**Sampling and Collecting Data**

**Vegetative Growth Characteristics:** Three plants were chosen randomly from every treatment in the three replicates at flowering stage (60 days after sowing) to measure plant growth characteristics i.e., plant length (the length of main stem cm), number of leaves/plant, number of branches/plant and dry weights of shoots (Leaves and stems) /plant. The samples of the vegetative parts were dried in the oven for 48 h at 75°C to a constant weight and then the dry weight per plant was calculated using the standard methods as illustrated by A.O.A.C. [26].

**Pods Yield and its Characteristics:** Random samples of 10 fresh pods in green mature stage at 95 days after sowing from each plot were taken to determine the following data:

Pod length (cm), Pod diameter (cm), Number of seeds /pod, Average pod weight (g), Weight of 100 green seeds (g) and Total pod yield (ton/fed).

**Chemical Properties of Pea Seeds as Well as Chlorophyll Contents:**

- Total leaf chlorophyll was measured at flowering stage (60 days after sowing) from the fourth upper leaves using Minolta chlorophyll Meter SPAD- 501 as SPAD units.
- Total protein%: It was determined as nitrogen in dry seeds content and converted to its equivalent protein content by multiplying N content x 6.25 [26].

Total nitrogen, phosphorus and potassium were determined in dry seed on the basis of dry weight according to the methods described by Bremner and Mulvaney [27]; Olsen and Sommers [28] and Jackson [29] respectively.

Total sugars, it was determined calorimetrically on the basis of seed dry matter, using spectrophotometer with the phenol sulphuric acid method described by Dubois *et al*. [30].

Total phenol, it was determined calorimetrically on the basis of seed dry matter, using spectrophotometer with the Folin-Ciocalteu method described by Singleton and Rossi [31].

**Statistical Analysis:** The obtained data were subjected to the proper analysis of variance (split-plot design) as described by Snedecor and Cochran [32] using M. stat program. Averages between treatments were differentiated by using LSD at 5% level.

## RESULTS AND DISCUSSION

### Vegetative Growth

**Effect of Extraction Methods:** Data in Table (3) demonstrate that, the tested methods of extraction treatments i.e., cold aqueous, hot aqueous and ethanolic extracts were induced significant effect on some vegetative growth parameters of pea plant i.e., plant length and dry weight/ plant. On the other hand according to number of branches and leaves / plant did not reach to significant level but, the treatment of hot aqueous extract gave the highest values of branches number, number of leaves / plant and dry weight/ plant in both growing seasons. These results agree with those obtained by Tsai *et al*. [18]; Prenesti *et al*.[12] and Ramirez-Rodrigues *et al*. [20] which they indicated that total phenolics were better extracted with hot water (100°C) than with cold water (25°C). Moreover, the variety and extraction conditions used (type of solvent, concentration, time and temperature) can potentially affect the polyphenolic profile of the extracts and thus makes comparisons between studies difficult [12-14]. In this regard, the higher concentration of polyphenolic compounds in hot water extracts may have contributed to a higher antioxidant activity in this extract as compared to cold water extract which had a positive effect on stimulate some growth activators synthesis, enhance plant cell growth and development as well as root growth factors that could positively affect on plant growth as mentioned by several investigators [2-7]. Moreover, Sakagami *et al.* [21] and Abdelfadel *et al*. [23] reported that, the hot water extracts of plants contain relatively higher amounts of high-molecular weight polysaccharides and lignin-carbohydrate complexes.

**Extracts Source:** Data in Table (3) illustrated that foliar spray with the extracts from the fresh or dry leaves of *Tamarix articulata* and *Ziziphus spina-christi* L. trees showed significant affection and caused increasing in the vegetative growth parameters of pea plant comparing with the control (water) in both seasons. The highest values for number of branches, number of leaves / plant and dry weight/ plant were obtained with foliar spray by extracts from dry leaves of *Tamarix articulata* and *Ziziphus spina-christi* L. trees. Meanwhile, foliar spray by extracts from fresh leaves of *Tamarix articulata* and *Ziziphus spina-christi* L. gave insignificant increase of plant length compared with the other treatments, this was true in both growing seasons. These results may be due to that, *Tamarix articulata* and *Ziziphus spina-christi* L. leaves extract consists of phenolic and polyphenolic, flavonoids, tannins, sterols, saponins and triterpenoids. Furthermore, 11 different alkaloids as mentioned by some investigator [10, 11]. The stimulatory effect of *Tamarix articulata* and *Ziziphus spina-christi* L. leaves extract may be related to all of these various substances present in these extracts that might affect cellular metabolism processes of treated plants, consequently led to all known beneficial effects on vegetative growth [5-7].

**Effect of the Interaction Between Extraction Methods and Extracts Source:** The results mentioned in Table (3) illustrated that the interaction between methods of extraction and extracts source showed significant effect on all vegetative growth parameters of pea plants except number of branches / plant which it did not show significant increment, these results were true in the both growing seasons, in addition, the highest values were obtained from the treatments which sprayed on the plants by hot aqueous extract from dry leaves of *Tamarix articulata* and *Ziziphus spina-christi* L. trees. In this regard Ramirez *et al*. [20] indicated that, the dried hibiscus hot water sample had the highest concentration of total polyphenols followed by dried hibiscus cold water, fresh hibiscus cold water and fresh hibiscus hot water extracts.

### Yield and its Components

**Effect of Extraction Methods:** Data recorded in Table (4) showed that, the tested methods of extraction treatments on green pods yield and its characters of peas, i.e., pod length, pod diameter, number of seeds/pod, pod fresh weight, fresh weight of 100 seed and total green pod yield. The obtained results showed that the effect of used methods induced significant effect on 100 green seeds weight and total green pod yield in both growing seasons in addition the pod fresh weight in the second season only. It was found that, garden pea plants which sprayed by hot aqueous extract gave the highest values of pod length, number of seeds/pod, pod fresh weight, 100 green seeds weight and total green pod yield in both growing seasons. These results agree with those obtained by Tsai *et al*. [18] and Prenesti *et al*. [12] which they indicated that total phenolics were better extracted with

Table 3: Effect of foliar spray by aqueous and ethanolic extracts of tamarix and ziziphus trees leaves on vegetative growth of pea plants during the two seasons of 2016/2017 and 2017/2018

| | | Plant length (cm) | | No. of branches/ plant | | No. of leaves/ plant | | Plant dry weight (g) | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 |
| Extraction methods | | | | | | | | | |
| Cold aqueous extract | | 46.31 | 45.98 | 4.56 | 4.38 | 34.50 | 33.83 | 8.15 | 8.08 |
| Hot aqueous extract | | 42.39 | 41.38 | 4.60 | 4.55 | 35.16 | 34.98 | 8.90 | 9.20 |
| Ethanolic extract | | 43.26 | 43.16 | 4.22 | 4.04 | 34.54 | 34.18 | 8.58 | 8.78 |
| L.S.D at 5% level | | 0.61 | 0.52 | NS | NS | NS | NS | 0.43 | 0.64 |
| Extract sources | | | | | | | | | |
| Water (control) | | 36.30 | 34.90 | 3.33 | 3.00 | 22.80 | 24.40 | 5.80 | 6.80 |
| Fresh leaf of tamarix | | 46.27 | 47.73 | 4.33 | 4.02 | 35.96 | 33.88 | 9.06 | 9.10 |
| Fresh leaf of ziziphus | | 48.84 | 46.93 | 4.76 | 4.63 | 36.77 | 36.16 | 9.25 | 9.02 |
| Dry leaf of tamarix | | 43.70 | 43.86 | 4.80 | 5.00 | 38.63 | 37.44 | 9.13 | 9.16 |
| Dry leaf of ziziphus | | 44.83 | 44.12 | 5.10 | 4.98 | 39.50 | 39.76 | 9.46 | 9.36 |
| L.S.D at 5% level | | 0.93 | 0.98 | 0.88 | 0.81 | 0.91 | 0.90 | 0.98 | 1.00 |
| The interaction between the factors | | | | | | | | | |
| Cold aqueous extract | Water (control) | 36.30 | 34.90 | 3.33 | 3.00 | 22.80 | 24.40 | 5.80 | 6.80 |
| | Fresh tamarix | 47.45 | 50.60 | 4.80 | 4.36 | 37.10 | 32.66 | 8.60 | 8.70 |
| | Fresh ziziphus | 56.83 | 53.20 | 5.10 | 5.03 | 37.61 | 37.50 | 9.55 | 9.41 |
| | Dry tamarix | 46.50 | 46.20 | 4.60 | 4.80 | 37.20 | 36.10 | 8.30 | 8.20 |
| | Dry ziziphus | 44.50 | 45.00 | 5.00 | 4.75 | 37.80 | 38.50 | 8.50 | 7.30 |
| Hot aqueous extract | Water ( control) | 36.30 | 34.90 | 3.33 | 3.00 | 22.80 | 24.40 | 5.80 | 6.80 |
| | Fresh tamarix | 43.28 | 44.90 | 3.90 | 3.70 | 34.50 | 33.70 | 9.90 | 10.20 |
| | Fresh ziziphus | 42.90 | 41.80 | 4.60 | 4.36 | 35.00 | 35.30 | 8.40 | 7.90 |
| | Dry tamarix | 43.50 | 41.00 | 5.20 | 5.50 | 41.70 | 39.02 | 10.10 | 10.00 |
| | Dry ziziphus | 46.00 | 44.33 | 6.00 | 6.20 | 41.80 | 42.50 | 10.30 | 11.00 |
| Ethanolic extract | Water ( control) | 36.30 | 34.90 | 3.33 | 3.00 | 22.80 | 24.40 | 5.80 | 6.80 |
| | Fresh tamarix | 48.10 | 47.70 | 4.30 | 4.00 | 36.30 | 35.30 | 8.70 | 8.40 |
| | Fresh ziziphus | 46.80 | 45.80 | 4.60 | 4.50 | 37.70 | 35.70 | 9.80 | 9.75 |
| | Dry tamarix | 41.10 | 44.40 | 4.60 | 4.70 | 37.00 | 37.20 | 9.00 | 9.30 |
| | Dry ziziphus | 44.00 | 43.03 | 4.30 | 4.00 | 38.90 | 38.30 | 9.60 | 9.68 |
| L.S.D at 5% level | 0.55 | 0.58 | NS | NS | 0.54 | 0.53 | NS | 0.59 | |

hot water (100°C) than with cold water (25°C), these results may be due to the higher concentration of polyphenolic compounds in hot water extracts may have contributed to a higher antioxidant activity in this extract as compared to cold water extract which had a positive effect on stimulate some growth activators synthesis, enhance plant cell growth and development as well as root growth factors that could positively affect on plant growth as shown in Table (2) and gave beneficially reflection on yield and its components as shown in the Table (3) as mentioned by several investigators [3- 7, 21, 23].

**Extracts Source:** According to the data in Table (4), the obtained results revealed that pod fresh weight, 100 green seeds weight and total green pods yield (ton/fed) were significantly increased with different extracts source comparing with the control (water) in both seasons and number of seeds/pod in the second season only. Whereas, foliar spray by extract of the dry leaves from *Tamarix articulata* and *Ziziphus spina-christi* L. trees gave the highest values of pod length, pod diameter, number of seeds/pod, pod fresh weight, 100 green seeds weight and total green pod yield in both growing seasons. The higher concentration of polyphenolic compounds in *Tamarix articulata* and *Ziziphus spina-christi* L. extracts may have contributed to a higher antioxidant activity in this extract as compared to the control (water) which it had a positive effect on enhance some vegetative growth parameter as shown in Table (2) and gave beneficially reflection on yield and its components as shown in Table (3) it was found that several investigators came to this results, i.e., Vijayalakshmi and Goswami [2]; Firoza and Maqbool [3]; Charu and Trivedi [4]; El-Khayat [5]; Abd El-Naem [6] and Abd-Allah and Ali [7].

Table 4: Effect of foliar spray by aqueous and ethanolic extracts of tamarix and ziziphus trees leaves on green pod yield and its characteristics of pea plants during the two seasons of 2016/2017 and 2017/2018

| | | Pod length (cm) | | Pod diameter (cm) | | No. green seeds/pod | | Pod weight (g) | | 100 green seeds weight (g) | | Total green pod yield (t/fed.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 |
| Extraction methods | | | | | | | | | | | | | |
| Cold aqueous extract | | 11.30 | 10.52 | 1.50 | 1.47 | 7.39 | 7.12 | 9.20 | 9.82 | 53.68 | 61.04 | 3.48 | 2.27 |
| Hot aqueous extract | | 11.66 | 10.67 | 1.50 | 1.47 | 7.71 | 7.26 | 10.06 | 10.60 | 58.28 | 61.68 | 3.91 | 3.09 |
| Ethanolic extract | | 11.63 | 10.72 | 1.54 | 1.47 | 7.78 | 7.24 | 9.58 | 10.22 | 53.70 | 60.16 | 3.41 | 2.46 |
| L.S.D at 5% level | | NS | NS | NS | NS | NS | NS | NS | 0.59 | 0.26 | 0.41 | 0.15 | 0.38 |
| Extract sources | | | | | | | | | | | | | |
| Water (control) | | 10.90 | 10.30 | 1.48 | 1.45 | 6.90 | 6.40 | 8.40 | 8.20 | 48.70 | 52.90 | 2.60 | 1.70 |
| Fresh leaf of tamarix | | 11.47 | 10.63 | 1.50 | 1.47 | 7.57 | 7.27 | 9.50 | 10.43 | 55.90 | 62.67 | 3.79 | 2.62 |
| Fresh leaf of ziziphus | | 11.66 | 10.60 | 1.52 | 1.48 | 7.73 | 7.33 | 9.90 | 10.60 | 54.57 | 62.43 | 3.68 | 2.87 |
| Dry leaf of tamarix | | 11.87 | 10.95 | 1.55 | 1.49 | 7.83 | 7.53 | 9.97 | 10.70 | 57.83 | 63.13 | 3.81 | 2.75 |
| Dry leaf of ziziphus | | 11.77 | 10.70 | 1.52 | 1.47 | 8.11 | 7.50 | 10.30 | 11.13 | 59.10 | 63.67 | 4.13 | 3.09 |
| L.S.D at 5% level | | NS | NS | NS | NS | NS | 0.79 | 0.93 | 0.86 | 0.86 | 0.96 | 0.40 | 0.34 |
| The interaction between the factors | | | | | | | | | | | | | |
| Cold aqueous extract | Water (control) | 10.90 | 10.30 | 1.46 | 1.45 | 6.90 | 6.40 | 8.40 | 8.20 | 48.70 | 52.90 | 2.60 | 1.67 |
| | Fresh tamarix | 11.30 | 10.40 | 1.50 | 1.48 | 7.40 | 7.00 | 8.90 | 10.10 | 53.60 | 61.30 | 3.65 | 2.43 |
| | Fresh ziziphus | 11.50 | 10.50 | 1.53 | 1.47 | 7.50 | 7.30 | 9.60 | 10.30 | 54.50 | 63.80 | 3.38 | 2.22 |
| | Dry tamarix | 11.40 | 10.70 | 1.52 | 1.49 | 7.40 | 7.50 | 9.10 | 9.90 | 54.30 | 63.50 | 3.80 | 2.23 |
| | Dry ziziphus | 11.40 | 10.70 | 1.48 | 1.48 | 7.77 | 7.40 | 10.00 | 10.60 | 57.30 | 63.70 | 3.99 | 2.82 |
| Hot aqueous extract | Water (control) | 10.90 | 10.30 | 1.49 | 1.45 | 6.90 | 6.40 | 8.40 | 8.20 | 48.70 | 52.90 | 2.60 | 1.67 |
| | Fresh tamarix | 11.40 | 10.60 | 1.45 | 1.46 | 7.40 | 7.30 | 9.70 | 10.30 | 58.60 | 63.90 | 4.07 | 3.00 |
| | Fresh ziziphus | 11.80 | 10.60 | 1.48 | 1.49 | 7.50 | 7.20 | 10.30 | 11.30 | 55.20 | 60.70 | 4.08 | 3.31 |
| | Dry tamarix | 12.20 | 11.15 | 1.56 | 1.50 | 8.30 | 7.70 | 10.80 | 11.50 | 63.00 | 64.30 | 4.16 | 3.58 |
| | Dry ziziphus | 12.00 | 10.70 | 1.51 | 1.47 | 8.47 | 7.70 | 11.10 | 11.70 | 65.90 | 66.60 | 4.64 | 3.89 |
| Ethanolic extract | Water (control) | 10.90 | 10.30 | 1.49 | 1.45 | 6.90 | 6.40 | 8.40 | 8.20 | 48.70 | 52.90 | 2.60 | 1.77 |
| | Fresh tamarix | 11.70 | 10.90 | 1.54 | 1.47 | 7.90 | 7.50 | 9.90 | 10.90 | 55.50 | 62.80 | 3.66 | 2.43 |
| | Fresh ziziphus | 11.67 | 10.70 | 1.54 | 1.49 | 8.20 | 7.50 | 9.80 | 10.20 | 54.00 | 62.80 | 3.58 | 3.09 |
| | Dry tamarix | 12.00 | 11.00 | 1.58 | 1.49 | 7.80 | 7.40 | 10.00 | 10.70 | 56.20 | 61.60 | 3.47 | 2.45 |
| | Dry ziziphus | 11.90 | 10.70 | 1.56 | 1.47 | 8.10 | 7.40 | 9.80 | 11.10 | 54.10 | 60.70 | 3.76 | 2.57 |
| L.S.D at 5% level | NS | NS | NS | NS | NS | NS | NS | NS | 0.51 | 0.57 | NS | 0.24 | |

**Effect of the Interaction Between Extraction Methods and Extracts Source:** The data in Table (4) show the effects of the interactions between methods of extraction and extracts source on green pods yield and its characters of peas, the data indicated that the best treatments for these parameters were obtained by foliar spray of hot aqueous extract from dry leaves of *Tamarix articulata* and *Ziziphus spina-christi* L. in both growing seasons. In this regard Ramirez *et al*. [20] indicated that, the dried hibiscus hot water sample had the highest concentration of total polyphenols followed by dried hibiscus cold water, fresh hibiscus cold water and fresh hibiscus hot water extracts. That might affect cellular metabolism processes of treated plants, consequently led to all known beneficial effects on vegetative growth as shown in Table (2) and gave beneficially reflection on yield and its components.

## Chemical Properties of Pea Seeds as Well as Chlorophyll Leaf Contents

**Effect of Extraction Methods:** Data in Table (5) illustrated that, the highest value with significant increase of total nitrogen (%) in the first season and Phosphorus (%) in the second season were obtained from pea plants sprayed by cold aqueous extract, while all treatments gave non-significant values of the Potassium % in both growing season. On the other hand the data showed that, chlorophyll leaf concentration increased by foliar spray with ethanolic extract in both growing seasons. These results may be due to using cold water as the solvents for extracting bioactive compounds which effect on stimulate nutrient absorption of NPK. In addition, the same trend were observed in Table (6) clear that, pea plants which sprayed by cold aqueous extract recorded a significant increase in total protein in the first season, total sugar in the second season and total phenol in both growing seasons. These results may be due to the cold extracts were more effective than hot extracts because the bioactive component present in the extracts might be thermo labile which might lose its activity when extracted under heat [22].

**Extracts Source:** Data recorded in Table (5) showed that, all studied chemical properties of pea seeds i.e., total nitrogen%, Potassium (%), Phosphorus (%) as well as chlorophyll leaf concentration were showed significant increase with different extracts source comparing with the control (water) in both seasons. Moreover, total protein, total sugar and total phenol were significantly increased as shown in Table (6) in both growing seasons.

Table 5: Effect of foliar spray by aqueous and ethanolic extracts of tamarix and ziziphus trees leaves on some chemical properties of pea seeds as well as chlorophyll leaves concentration of pea plants during the two seasons of 2016/2017 and 2017/2018

| | | N% | | P % | | K % | | Leaf chlorophyll reading SPAD | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 |
| Extraction methods | | | | | | | | | |
| Cold aqueous extract | | 2.82 | 2.74 | 0.71 | 0.67 | 1.85 | 1.92 | 43.58 | 45.66 |
| Hot aqueous extract | | 2.76 | 2.74 | 0.63 | 0.63 | 1.95 | 1.91 | 47.76 | 45.66 |
| Ethanolic extract | | 2.65 | 2.69 | 0.72 | 0.66 | 1.86 | 1.80 | 48.32 | 48.17 |
| L.S.D at 5% level | | 0.13 | NS | N.S | 0.03 | N.S | N.S | 0.82 | 0.99 |
| Extract sources | | | | | | | | | |
| Water (control) | | 2.10 | 2.03 | 0.43 | 0.51 | 1.63 | 1.60 | 38.50 | 36.68 |
| Fresh leaf of tamarix | | 2.98 | 2.93 | 0.71 | 0.68 | 2.00 | 2.08 | 50.00 | 50.71 |
| Fresh leaf of ziziphus | | 3.03 | 2.96 | 0.74 | 0.66 | 1.87 | 1.84 | 47.13 | 47.82 |
| Dry leaf of tamarix | | 2.71 | 2.79 | 0.81 | 0.75 | 2.00 | 1.94 | 48.20 | 48.90 |
| Dry leaf of ziziphus | | 2.90 | 2.92 | 0.76 | 0.66 | 1.94 | 1.94 | 48.93 | 48.36 |
| L.S.D at 5% level | | 0.20 | 0.41 | 0.02 | 0.03 | 0.2 | N.S | 0.94 | 1.00 |
| The interaction between the factors | | | | | | | | | |
| Cold aqueous extract | Water (control) | 2.10 | 2.03 | 0.43 | 0.51 | 1.63 | 1.60 | 38.50 | 36.80 |
| | Fresh tamarix | 3.09 | 3.10 | 0.68 | 0.62 | 2.07 | 2.16 | 46.10 | 49.90 |
| | Fresh ziziphus | 2.88 | 2.90 | 0.79 | 0.70 | 2.06 | 2.18 | 44.60 | 46.40 |
| | Dry tamarix | 2.70 | 2.57 | 0.93 | 0.89 | 1.80 | 1.72 | 44.10 | 48.30 |
| | Dry ziziphus | 3.32 | 3.10 | 0.74 | 0.64 | 1.71 | 1.95 | 44.60 | 46.90 |
| Hot aqueous extract | Water (control) | 2.10 | 2.03 | 0.43 | 0.51 | 1.63 | 1.60 | 38.50 | 36.80 |
| | Fresh tamarix | 2.98 | 2.82 | 0.71 | 0.75 | 1.77 | 1.90 | 50.90 | 49.90 |
| | Fresh ziziphus | 3.09 | 2.88 | 0.69 | 0.64 | 1.79 | 1.71 | 47.90 | 46.40 |
| | Dry tamarix | 2.88 | 3.09 | 0.68 | 0.66 | 2.27 | 2.12 | 48.60 | 48.30 |
| | Dry ziziphus | 2.77 | 2.88 | 0.65 | 0.61 | 2.31 | 2.24 | 52.90 | 46.90 |
| Ethanolic extract | Water (control) | 2.10 | 2.03 | 0.43 | 0.51 | 1.63 | 1.60 | 38.50 | 36.46 |
| | Fresh tamarix | 2.88 | 2.87 | 0.75 | 0.68 | 2.18 | 2.18 | 53.00 | 52.33 |
| | Fresh ziziphus | 3.10 | 3.09 | 0.74 | 0.66 | 1.77 | 1.63 | 48.90 | 50.66 |
| | Dry tamarix | 2.56 | 2.70 | 0.81 | 0.70 | 1.93 | 1.98 | 51.90 | 50.10 |
| | Dry ziziphus | 2.60 | 2.77 | 0.88 | 0.74 | 1.80 | 1.63 | 49.30 | 51.30 |
| L.S.D at 5% level | | 0.11 | NS | 0.01 | 0.01 | 0.15 | N.S | 0.56 | 0.59 |

These results may be due to that, *Tamarix articulata* and *Ziziphus spina-christi* L. leaves extract consists of phenolic and polyphenolic, flavonoids, tannins, sterols, saponins and triterpenoids. Furthermore, 11 different cyclopeptide alkaloids [10, 11]. The stimulatory effect of *Tamarix articulata* and *Ziziphus spina-christi* L. leaves extract may be related to all of these various substances present in these extracts that might affect on cellular metabolism processes of treated plants, consequently led to all known beneficial effects on chemical properties [5-7].

**Effect of the Interaction Between Extraction Methods and Extracts Source:** The data in Table (5) show the effects of the interactions between methods of extraction and extracts source on chemical properties of pea seeds i.e. total Nitrogen (%) and Phosphorus (%) and Potassium (%) data indicated that the best treatments for these parameters were obtained with foliar spray by hot or cold aqueous extract from dry or fresh leaves of *Tamarix articulata* and *Ziziphus spina-christi* L. in both growing seasons. Regarding chlorophyll in the pea leaves, all the previous treatments induced significant effect at 5% level especially foliar spray by ethanolic extract from fresh leaves of *Tamarix articulata* in both g rowing seasons. Also, data in Table (6) illustrate that, total protein in the first season; total sugar and total phenol in both growing seasons were significantly increased by foliar spray of hot or cold aqueous extract from dry or fresh leaves of *Tamarix articulata* and *Ziziphus spina-christi* L. In this regard Ramirez *et al*. [20] indicated that, the dried hibiscus hot water sample had the highest concentration of total polyphenols followed by dried hibiscus cold water, fresh hibiscus cold water and fresh hibiscus hot water extracts.

Table 6: Effect of foliar spray by aqueous and ethanolic extracts of tamarix and ziziphus trees leaves on some chemical properties of pea seeds of pea plants during the two seasons of 2016/2017 and 2017/2018

| | | Total protein % | | Total sugar % | | Total phenol % | |
|---|---|---|---|---|---|---|---|
| Treatments | | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 | 2016/2017 | 2017/2018 |
| Extraction methods | | | | | | | |
| Cold aqueous extract | | 17.61 | 17.13 | 21.18 | 21.54 | 0.59 | 0.58 |
| Hot aqueous extract | | 17.28 | 17.13 | 20.87 | 20.97 | 0.51 | 0.48 |
| Ethanolic extract | | 16.55 | 16.83 | 20.66 | 20.93 | 0.44 | 0.38 |
| L.S.D at 5% level | | 0.83 | NS | N.S | 0.26 | 0.12 | 0.08 |
| Extract sources | | | | | | | |
| Water (control) | | 13.13 | 12.71 | 17.04 | 17.73 | 0.34 | 0.27 |
| Fresh leaf of tamarix | | 18.65 | 18.31 | 21.11 | 21.53 | 0.46 | 0.48 |
| Fresh leaf of ziziphus | | 18.91 | 18.47 | 21.77 | 21.63 | 0.69 | 0.63 |
| Dry leaf of tamarix | | 16.94 | 17.42 | 23.37 | 23.11 | 0.44 | 0.42 |
| Dry leaf of ziziphus | | 18.11 | 18.23 | 21.24 | 21.72 | 0.63 | 0.59 |
| L.S.D at 5% level | | 1.25 | 2.56 | 0.50 | 0.35 | 0.09 | 0.08 |
| The interaction between the factors | | | | | | | |
| Cold aqueous extract | Water (control) | 13.13 | 12.71 | 17.04 | 17.73 | 0.34 | 0.27 |
| | Fresh tamarix | 19.31 | 19.38 | 23.19 | 23.37 | 0.51 | 0.59 |
| | Fresh ziziphus | 18.00 | 18.13 | 20.01 | 20.62 | 0.84 | 0.73 |
| | Dry tamarix | 16.88 | 16.06 | 22.21 | 22.15 | 0.43 | 0.54 |
| | Dry ziziphus | 20.75 | 19.38 | 23.46 | 23.83 | 0.85 | 0.76 |
| Hot aqueous extract | Water (control) | 13.13 | 12.71 | 17.04 | 17.73 | 0.34 | 0.27 |
| | Fresh tamarix | 18.63 | 17.63 | 21.27 | 21.71 | 0.39 | 0.39 |
| | Fresh ziziphus | 19.36 | 17.98 | 21.49 | 21.27 | 0.58 | 0.63 |
| | Dry tamarix | 17.98 | 19.31 | 24.28 | 23.54 | 0.56 | 0.43 |
| | Dry ziziphus | 17.31 | 18.01 | 20.29 | 20.62 | 0.69 | 0.68 |
| Ethanolic extract | Water (control) | 13.13 | 12.71 | 17.04 | 17.73 | 0.34 | 0.27 |
| | Fresh tamarix | 18.00 | 17.94 | 18.89 | 19.52 | 0.50 | 0.47 |
| | Fresh ziziphus | 19.38 | 19.31 | 23.82 | 23.02 | 0.67 | 0.52 |
| | Dry tamarix | 15.98 | 16.88 | 23.62 | 23.65 | 0.34 | 0.30 |
| | Dry ziziphus | 16.26 | 17.31 | 19.97 | 20.73 | 0.36 | 0.33 |
| L.S.D at 5% level | | 0.74 | NS | 0.29 | 0.20 | 0.05 | 0.05 |

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