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EFFECT OF SPRAYING ZINC ELEMENT FERTILIZER ON THE GROWTH AND YIELD OF GREEN PEA (*PISUM SATIVUM* L.) SEEDS

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Abstract

This study was implemented during the growing seasons (2012 / 2013 & 2013 / 2014) at Vegetable Research Field. Department of Horticulture and Landscape Design, College of Agriculture & Forestry, Mosul University, Iraq. Evaluate the response of two pea cultivars (Mezza Rama & Little Marvel) to spraying zinc in three concentrates (zero, 30 and 60) mg.liter^{-1} in the characteristics vegetative growth and quantitative and qualitative yield of green pea seeds. Chelated fertilizer (Dissolving – E–Zn) containing 15% Zn used a spray on vegetative growth of the plant in three periods. The first application was a month after sowing. Whereas the second was 60 days after sowing. The three application was 90 days after sowing.

The experiment included 6 treatments (2×3) arranged in Complete Randomized Block Design with three replicates.

The results showed that the two zinc treatments significantly exceeded the control treatment in all vegetative characteristics and the quantitative and qualitative yield of green pea seeds. Results showed that the spray concentration of 30 mg Zn.L^{-1} caused a significant increase in the two characteristics of single leaf area and length pod during the two growing seasons and total leaf area of plant, number of seeds pod, pod weight, plant seed yield, percentage of protein, nitrogen and potassium in seeds during the first season and weight of 100 green seeds in the second growing season compared to the treatment of spray conc. 60 mg Zn.L^{-1}. The cultivar Mezza Rama was significantly superior to the cultivar of Little Marvel in the traits of single leaf area, total leaf area of plant, length pod, weight of 100 green seeds and % K in the green seeds during the two growing seasons and the green seed yield for plant and the hectare during the first season and the % protein in the seeds during second growing season. The both interaction treatments of (30 mg Zn . l^{-1} +Mezza Rama cv. And 60 mg Zn.l^{-1} + Mezza Rama *cv.*) recorded the highest significant values for most vegetative growth and quantitative and qualitative yield characters of green pea seeds.

Key words: pea, cultivars, Mezza Rama, Little Marvel, Spray, zinc.

Introduction

Pea (*Pisum sativum* L.) is one of the plants of the Fabaceae family, which ranks fourth in the economic importance of the Fabaceae family and comes in second place after the tomato crop as raw material for canning factories. It is an of the annual herbaceous plants limited or unlimited growth and adapted to wet climatic conditions (Boras,1992). Pea are grown for their fresh green seeds or dry seeds and sugary pods, it is consumed as cooked or canned or frozen food, it is a vegetables rich in protein and carbohydrates and nutrients, on the agricultural side pea production plays an important role in the agricultural cycle as it is a crop that contributes to the stabilization of atmospheric nitrogen and improves soil fertility (Davies, 1985 and Hassan, 2002). The total area of the global pea cultivation for 2017 (2669305) hectare, whose production reached (20699736) tons of green seeds with a production rate of 7.755 t.Ha^{-1} and the state of Albany and Spain topped the green production of pea (F.A.O, 2017), for the Arab world, Algeria ranked first in the pea cultivation area in 2014 which amounted to 35540 hectares, the highest production of green pea for 2014 was recorded by Egypt with 10.034 t.Ha^{-1} (Arab Organization for Agricultural Development, 2015).

In view of the increasing world population and the absence in the production of food, especially vegetables, led researchers to develop varieties of plant productivity and high nutritional value . many researchers have noted

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differences between pea varieties in terms of vegetative growth or quantitative and qualitative yield (Hassan, 2002). In a study by Yemane and Skjelvag (2003) to find out the chemical differences in the mineral concentration of plants and pea seeds for two varieties (Dekoko, Ater), they found that plant cultivar Ater gave the highest values of the plant content of the nitrogen element, while the cultivar Dekoko recorded the highest value of the concentration of phosphorus and potassium in seeds. Ali *et al.,* (2007) found that the cultivar Lincoln Green Feast showed an increase in the weight of the plant's soft seeds compared to the local variety. Saleh *et al.,* (2010) found that Mammoth melting cultivar were significantly higher in plant weight than spring cultivar. Dohuky *et al.,* (2011) compared three pea cultivars (Canadian, Local smooth, Local crinkled) found that Local smooth cultivar gave the highest values in traits number leaves.plant^{-1}, total leaf area.plant^{-1} and chlorophyll percentage compared to the other two cultivars. Mohammed and Saleh (2012) indicated that the Para Field cultivar was significantly superior to Santi cultivar in the number branches.plant^{-1} and number pods.plant^{-1} during two seasonal growth and number seeds.pod^{-1} for the first season, while the Santi cultivar was superior to the Para Field cultivar in the 100 seed weight and hectare seed yield indicated Hamdoun (2013) in her study, which included two varieties of pea (Little Marvel, Fabreca) that the Little Marvel variety was superior to the other variety in pod weight, number seeds.pod^{-1} and protein concentration in seeds.

Iraqi soil in general has a neutral pH that tends to alkaline and depends on its lime content, making some nutrients unavailable and difficult to absorb by plant roots (Abu Dhahi and Al- Yunis, 1988) and thus the inability of plants to cover their needs of micro nutrients such as zinc and other elements. Zinc in the soil is much less soluble if the pH is greater than 6 and is fully stabilized in the soil when soil pH reaches 9 (Sharma and Matiramini, 1969). As aresult, the lack of concentrated zinc concentration in soil will negatively affect plant growth and productivity (AL-Rawy, 1998). This indicates that it is necessary to pay attention to zinc fertilization. A study conducted by Esho *et al.,* (2009) for two seasons showed that the seeds of two varieties of pea (Joff and Anwared) were immersed with zinc sulphate solution at 0.25,0.5 and 1% concentrations for 12 hours, exceeded control treatment, which gave in the traits of vegetative growth, as well in the weight pod and number of pods.plant^{-1}, which was reflected positively in the increase of the plant yield and productivity of the unit area . In their study for two seasons, El-Gizawy and Mehasen (2009) showed that spraying of broad bean plants with the zinc element in conce. 0.02, 0.04 and 0.06% was significantly superior to the control treatment in the traits weight of 100 seed, number pods.plant^{-1}, seed yield.plant^{-1}, seed yield.Ha^{-1} and the percentage of protein, N, P and K in seeds. Rafique *et al.,* (2015) noted that the addition of zinc at conce. 2, 4, 8 and 16 kg.h^{-1} to the soil of plants of three varieties of pea (Meteor, Climax and Green feast) increase the concentration of zinc in the leaves pea plants at varying rates according to different pea varieties, which was reflected in increasing the seed content of the zinc element. Saad (2015) noted that broad bean plants, which were sprayed at a conce. 25 and 50 mg.L^{-1}, significantly exceeded the control treatment in the number branches.plant^{-1}, number leaves.plant^{-1}, leaf area.plant^{-1}, fresh weight.plant^{-1} and chlorophyll ratio, record spray conce. 50 mg.L^{-1} best results for previous qualities.

Since most of Iraq's soils tend to alkaline which makes some nutrients unavailable and difficult to be absorbed by plant roots, this study was carried out to investigate

Table 1: some of the chemical and physical properties of the soil of the field of experience in the two seasons of cultivation.

Traits and Measuring unit	Location of the experiment field for the first season (2012/2013). Depth (0-30cm)	Location of the experiment field for the first season (2012/2013). Depth (0-30cm)
pH	7.68	7.89
EC ds.m^{-1}	0.919	0.569
Organic Matter g.kg^{-1}	35.37	13.39
Ready focus of elements		
Nitrogen ready mg.kg^{-1}	20.7	27.7
Phosphorus ready mg.kg^{-1}	13.2	18.34
Potassium ready mg.kg^{-1}	100.2	153.1
Sodium mg.L^{-1}	1.39	0.78
Calcium mg.L^{-1}	7.75	1.45
Magnesium mg.L^{-1}	11.25	3.15
Chloride mg.L^{-1}	2.6	3
Total Carbonate g.kg^{-1}	334.8	246.5
Zinc mg.kg^{-1}	0.35156	0.20271
Volumetric distribution of soil tissue		
Sand g.kg^{-1}	615	681.2
Silt g.kg^{-1}	263.7	196
Clay g.kg^{-1}	121.3	122.8
Tissue	Sandy loam	Sand loam

*The analysis was carried out in the central laboratory of the faculty of agriculture and forestry/ university of Mosul.

Table 2: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait number of plant branches (no. of branches plant^{-1}), during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	5.980 e	8.302 c	8.329 c	7.537 b
Little Marvel	7.309 d	9.109 b	9.869 a	8.762 a
Average zinc	6.644 b	8.706 a	9.099 a	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	9.211 c	11.018 b	12.220 b	10.816 a
Little Marvel	9.167 c	12.103 b	13.611 a	11.627 a
Average zinc	9.189 c	11.561 b	12.916 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 3: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of single leaf area (cm^2) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	92.077 b	104.406 a	97.246 ab	97.91 a
Little Marvel	66.944 d	82.590 c	76.424 c	75.32 b
	79.511 c	93.498 a	86.836 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	149.124 c	178.291 a	162.024 b	163.147 a
Little Marvel	103.384 e	118.957 d	114.951 d	112.431 b
Average zinc	126.254 c	148.624 a	138.488 b	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 4: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of total leaf area of plant (cm^2) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	9510.7 c	12197.6 a	11208.2 ab	10972.2 a
Little Marvel	8002.1 d	11247.7 ab	10626.6 b	9958.8 b
Average zinc	8756.4 c	11722.7 a	10917.4 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	17791.0 bc	23094.7 a	21590.8 a	20825.5 a
Little Marvel	13691.4 d	17270.3 c	19326.4 b	16762.7 b
Average zinc	15741.2 b	20182.5 a	20458.6 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

the effect of adding the zinc element by spraying in the vegetative and yield characteristics of the two pea cultivars (Mezza Rama, Little Marvel).

Materials and Methods

The field experiment was implemented at vegetables field, Department of Horticulture and Landscape, Faculty of Agricultural and Forestry, Mosul University, Iraq, during two seasons (2012/2013 and 2013/2014), to study the effect of paper spraying of the zinc element in vegetative growth and the quantitative and qualitative yield of the two pea Mezza Rama and Little Marvel, the soil samples were taken randomly from the experiment site in the field and both seasons before planting and at a depth of 0-30 cm, the soil samples were mixed well and a representative sample of the experiment

field was used for analysis at the central laboratory of the faculty of agriculture and forestry / university of Mosul to estimate some chemical and physical traits . The results of the analysis are shown in table (1), the soil of experiment was plowed and prepared for agriculture in September during the two seasons of agriculture (2012/2013 and 2013/2014) and divided to ridges into a length of 2.75 m and a width of 0.75 m, the secondary irrigation pipes were then placed on the top of each ridge of agriculture ridges, the farming lines were then covered with a plastic cover (Soil mulching), the seeds of both cultivars were grown on 10/11 during the first planting season 2012 and the second season 2013. Crop service operations such as irrigation, deforestation and fertilization, which included the addition of ammonia (46% nitrogen) were performed during the two planting seasons, the first one after 30 days of planting at 40 g for the experimental unit (20g /ridge) and the second batch at the beginning of plant flocculation after 102 days of cultivation (Matlub *et al.,* 1989). A superphosphate fertilizer was used with 107 kg / ha^{-1} and

Table 5: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait total chlorophyll of leaves (%) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	37.852 d	46.482 ab	43.637 bc	42.657 a
Little Marvel	41.922 c	48.272 a	46.898 ab	45.697 a
Average zinc	39.887 b	47.377 a	45.267 a	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	39.724 c	43.471 ab	46.516 a	43.237 a
Little Marvel	36.053 d	39.030 cd	41.947 bc	39.010 a
Average zinc	27.889 c	41.251 b	44.231 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 6: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of fresh weight for a plant (g) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	434.87 ab	469.92 a	467.31 a	457.37 a
Little Marvel	319.60 d	378.96 bc	404.86 bc	367.81 b
Average zinc	377.24 b	424.44 a	436.08 a	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	505.43 b	551.22 a	577.61 a	545.42 a
Little Marvel	384.95 d	447.04 c	460.24 c	430.74 b
Average zinc	446.19 b	499.13 a	518.93 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 7: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of dry weight for a plant (g) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	83.050 bc	94.549 a	88.824 ab	88.808 a
Little Marvel	65.617 d	75.957 c	80.748 bc	74.107 b
Average zinc	74.334 b	85.253 a	84.786 a	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	110.253 b	129.150 a	129.224 a	122.876 a
Little Marvel	91.305 c	105. 167 bc	94.503 c	96.992 a
Average zinc	100.779 b	117.158 a	111.864 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

was added to the soil by ditching along the line of agriculture in the middle of it before planting, at a rate of 44.13 g for experimental unit as recommended (Hassan, 2002).

A global experience (3×2) was used. The first factor included three levels of zinc (0, 30 and 60) mg.L^{-1}, the zinc element was used in the form of the commercial fertilizer (Dissolvine-E-Zn), which contains the zinc component at a concentration 15%, the product is from the company M-Fort-Holland. Zinc was added to the leaves of the pea plants three times on the first spray after 30 days of planting, while the second spray after 6 days of planting and the third spray after 90 days of planting, add tween-20 with 1% to reduce surface tension of water molecules, spray the plants in the early morning and to the point of complete of wetness of the plants in the spray solution (Hassan, 2000). The second factor is represented by two pea varieties, the variety Mezza Rama (Produced by the Italian company Hurtus, first cultivated in Iraq) and variety Little Marvel (one of pea varieties produced by the U.S.A company Northrop–King Company, is one of the varieties of short-lived pea, commonly cultivated in northern Iraq). The experiment treatments (3×2) were arranged in both planting seasons using the Complete Randomized Block Design with three replicates. Each experimental unit contains two ridges 2.75 m. × 0.75 m . sowing was done on one side of the ridge at a distance of 25 cm between the plants resulting in 20 plant /exp. unit. The results were statistically analysis according to the statistical analysis system SAS (SAS 1998) and compared with the means by Duncan multiple rang test at 0.05 level (Al-Rawy and Kalaf, 2000).

Five plants were selected from the center of ridge 1 for each experimental unit to measure the traits of vegetative growth (number leaves.plant^{-1}, single leaf area (cm^{-2}). The cloning method was used to extract the paper area of the plant (Patton, 1984 and Saied, 1990), number branches.plant^{-1}, total chlorophyll of leaves was measured as SPAD units using Minolta Chlorophyll Meter Model SPAD 502), fresh weight of plant

(g)). As for the traits of the components of green pea yield included number pods.plant^{-1}. measured (number of total pods of experimental unit / number of experimental plants per unit), number seeds.pod^{-1}, green pod weight (g), weight 100 green seeds (g), yield of green seeds.plant^{-1} (g). measured (total seed of experimental unit/number of experimental plants per unit), yield of green seed per hectare (ton.Ha^{-1}) . Mineral content in leaves (N%, P%, K%, Zn (mg.kg^{-1} dry matter)) .The mineral contents were estimated using the wet ash procedure for the dry powdered. Nitrogen was determined. using modified micro– Kjeldahl according to method of Huphries (1965). Phosphorus was determined by modified spectrophotometer method according to Rowell, (1993). Potassium contents were determined using flame photometer according to methods of Brown and Lilland (1964). Determination of the zinc element for the first season only using an atomic absorption spectrophotometer according to methods of Jackson(1958).

Results

Characteristics of vegetative growth:

Data from tables (2, 3, 4, 5, 6 and 7) show that the spraying of the zinc element on the pea plants had a significant effect on all vegetation traits during the two growing seasons, spray concentrations of 30 and 60 mg Zn.L^{-1} on pea plants did not in some vegetative growth characteristics during the growing seasons except that the spray treatment of 30 mg Zn.L^{-1} on pea plants significantly exceeded the spray treatment of 60 mg Zn.L^{-1} on pea plants in two traits single leaf area by 7.67 and 7.32% during the two growing seasons and total leaf area. plant^{-1} by 7.38% during the first season, while the spray treatment of 60 mg Zn.L^{-1} on pea plants significantly exceeded the spray treatment of 30 mg Zn.L^{-1} on pea plants in two traits branches number.plant^{-1} by 1.17% during the second season and total chlorophyll of leaves by 7.22% during the second season, the results of tables (2, 3, 4, 5, 6 and 7) the control treatment (without spraying) recorded the lowest values of most vegetative growth characteristics during the two growth seasons.

The results of vegetable growth tables (2, 3, 4, 5, 6 and 7) the Mazza Rama *cv.* was significantly superior to the Little Marvel cv. in the traits of the single leaf area by a percentage reached 30.00 and 45.11%, total leaf area of plant by 10.18% and 21.85% and the fresh weight.plant^{-1} by more than reached 24.35% and 26.62% respectively, during the two growth seasons of these traits as well as in the trait dry weight.plant^{-1} by 18.86% in the first growing season. On the other hand, the Little Marvel cv. was significantly higher than the Mezza Rama cv. in the trait number branches.plant^{-1} by 16.25% during the first season.

The results of vegetative growth characteristics (Tables 2, 3, 4, 5, 6, 7) showed that the interaction treatment sprayed 30mg Zn.L^{-1} + Mezza Rama *cv.* recorded the highest values in the characteristics of the single leaf area (104.406 and 178.291cm^{-2}) and total leaf area of plant (12197.6 and 23094.7cm^{-2}) during the two growth seasons and fresh weight.plant^{-1} 469.92g and dry weight.plant^{-1} 94.549g during the first growing season, While the reaction treatment gave spray of 60 mg Zn.L^{-1} + cultivar Mezza Rama the highest values for total chlorophyll of leaves 46.516%, fresh weight.plant^{-1} 577.61g and dry weight.plant^{-1} 129.224g during the second growing season. In contrast, the interaction sprayed 30 mg Zn.L^{-1} + cultivar Little Marvel the highest values in the characteristics of number branches. plant^{-1} (9.869 and 13.611) during the two growth seasons and total chlorophyll of leaves 46.898% during the first season.

Discussion

The reason for the superiority of the sprayed pea plants in the zinc element may be attributed to the two traits branches number.plant^{-1} and areas single leaf (Tables 2, 3) for the role of the important zinc element in the plant's bio-building processes and the increase in photosynthetic process products, as well as its important role in the formation and activation of enzymes and growth hormones responsible for division and elongation of the plant cell. Mohamed (1977) mentioned that the zinc element contributes to the process of building and forming chlorophyll molecules and has important role in the process of building and forming the protein and activates many of the enzymes, including starch production. Price *et al.,* (1972) and Togay *et al.,* (2004) reported that zinc plays an important role in the synthesis of RNA nucleic acids, which contribute to the production of proteins responsible for the formation of enzymes and plant hormone. The increase in the total paper of the plant (Table 4) was the final result of increasing the number of leaves of the plant sprayed with the zinc element as a result of increasing the number of plant branches (Table 2) in addition to increasing the area of one plant leaf (Table 3). The reason for the increased concentration of total chlorophyll (Table 5) by spraying the zinc element may be due to the effect of this element on increasing the work and efficiency of chloroplasts responsible for producing chlorophyll. AL-Naimy (1984) noted that the zinc element plays an important role in increasing the activation of a large number of enzymes, including Enolase and Carbonic anhydrase found in

chloroplasts, which have an important role in regulating the pH within the chloroplasts, thus protecting the proteins within it from the change in nature. The increase in the fresh weight of a plant by sprinkling the zinc element may be due to the increase in the vegetative growth components represented by the number of branches and leaves plant and the total leaf area of plant (Tables 2, 3 and 4). The increase in the dry weight of the plant (Table 7) was the final result of the fresh weight of the plant (Table 6). These results are consistent with Esho *et al.,* (2009) and Saad (2015).

Table 8: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait number pods.plant^{-1} during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	41.389 c	43.773 c	46.413 c	43.859 b
Little Marvel	60.896 b	69.659 a	66.393 a	65.649 a
Average zinc	51.143 b	56.716 a	56.403 a	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	56.188 d	61.129 c	63.680 c	60.332 b
Little Marvel	70.670 b	82.287 a	80.018 a	77.670 a
Average zinc	63.447 b	71.708 a	71.849 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 9: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of pod length (cm) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	10.022 b	12.480 a	11.816 a	11.439 a
Little Marvel	6.901 d	8.119 c	7.688 c	7.569 b
Average zinc	8.462 c	10.299 a	9.752 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	10.237 b	11.222 a	11.191 a	10.883 a
Little Marvel	7.254 e	8.832 c	8.064 d	8.050 b
Average zinc	8.746 c	10.027 a	9.627 b	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 10: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait number seeds.pod^{-1}during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	6.7889 b c	8.2811 a	7.1833 b	7.418 a
Little Marvel	6.7044 c	7.0389 b c	6.8033 b c	6.849 a
Average zinc	6.7467 b	7.6600 a	6.9933 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	6.4582 b	7.0200 a	7.2544 a	6.911 a
Little Marvel	5.9378 c	6.4582 b c	6.1567 b	6.184 a
Average zinc	6.0483 b	6.7391 a	6.7056 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

The superiority of the Mezza Rama variety may be attributed to the positive interaction of the genotype of this species with environmental conditions (climate, soil), this has led to an increase in the root size of the Mezza Rama variety compared to the Little Marvel variety, This was evident from field observation, this may contribute to increasing the absorption of a large amount of nutrients available in the soil

and the increase of nutrients within the plant may increase the efficiency of photosynthesis and the production of energy compounds (sugars), which may have increased the components of the vegetative growth of the variety Mezza Rama. Hassan (2002) and Salih *et al.,* (2010), noted the many varieties of pea scattered around the world are different from one another in morphological and genetic characteristics, pea varieties are classified under number of varietal types, which vary in their characteristics. Results of tables (2, 3, 4, 5, 6, 7) are consistent with those found by Dohuky *et al.,* (2011) and Muhammad and Salah (2012) about variations in vegetative growth traits of pea varieties.

Characteristics of yield and their components:

The results of tables (8, 9, 10, 11, 12, 13 and 14) indicate that spray treatment is 30 mg Zn.L^{-1} resulted in a significant increase in all yield characteristics and components during the two growth seasons, except for the number pods. Plant^{-1} during the second growing season, which significantly exceeded the spray treatment of 30 mg Zn.L^{-1} to pea plants on a spray treatment of 60 mg Zn.L^{-1} to pea plants in the

characteristics of pod length by percentage reached 5.61 and 4.15% during the two growth seasons and the number seeds.pod^{-1} by 9.53%, weight of the green pod by 6.057%, green seeds yield.plant^{-1} by 5.72% and green seeds yield.Ha^{-1} by 5.06% during the first growth season for these traits and the weight of 100 green seeds by 5.65% during the second growing season . The results of the tables (8, 9, 10, 11, 12, 13 and 14) showed that spraying of the zinc element on pea plants at a concentration of 30 or 60 mg Zn.L^{-1} was significantly superior to control treatment in all yield characteristics and components, the control treatment recoded the lowest values yield characteristics and components (Tables 8, 9, 10, 11, 12, 13, 14).

Table 11: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait green pod weight (g) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	8.784 b	9.922 a	9.557 a	9.421 a
Little Marvel	5.113 e	6.570 c	5.920 d	5.868 b
Average zinc	6.949 c	8.246 a	7.738 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	7.981 b	8.951 a	9.046 a	8.659 a
Little Marvel	4.672 d	5.334 c	4.879 d	4.962 b
Average zinc	6.327 b	7.143 a	6.962 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 12: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait weight 100 green seeds (g) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	57.950 b	63.744 a	61.338 a b	61.011 a
Little Marvel	41.779 d	47.894 c	44.967 c d	44.880 b
Average zinc	.864 b49	55.819 a	53.152 a	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	50.630 c	56.234 a	52.765 b	53.210 a
Little Marvel	39.332 f	44.033 d	42.139 e	41.835 b
Average zinc	44.981 c	50.133 a	47.452 b	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 13: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait yield of green seeds.plant^{-1}(g) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	176.42 b	207.55 a	215.21 a	199.73 a
Little Marvel	161.80 c	212.17 a	181.81 b	185.26 b
Average zinc	169.11 c	209.86 a	198.51 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	210.69 c d	243.41 b	273.59 a	242.56 a
Little Marvel	190.82 d	231.84 b c	219.64 c	214.10 a
Average zinc	200.76 b	237.62 a	246.61 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

The results of yield and its components (Tables 8, 9, 10, 11, 12, 13, 14) showed that Mezza Rama *cv.* is significantly higher than the Little Marvel *cv.* in the traits of pod length by percentage reached 51.13 and 27.19%, weight green pod by 60.55 and 74.51% and weight of 100 green seeds by 35.94 and 27.19% respectively during the two growth seasons and green seeds yield.plant^{-1} by 7.81% and green seeds yield.Ha^{-1} by 7.32% during the first growth season. On the other hand Little Marvel *cv.* was significantly superior to the Mezza Rama *cv.* in the trait of number pods. Plant^{-1} with a percentage reached 49.68% and 28.74% respectively during the two growth seasons.

Results showed characteristics of yield and its components (Tables 8, 9, 10, 11, 12, 13, 14) that the interaction treatment sprayed 60 mg Zn.L^{-1} + Mezza Rama *cv.* recorded the highest values of the number seeds.pod^{-1} 7.254 and green pod weight 9.046g during the second growing season and yield of green seeds.plant^{-1} 215.21 and 273.59g and yield of green seeds.Ha^{-1} 9.182 and 11.199 ton respectively during the two growth season. While the interaction treatment sprayed 30 mg Zn.L^{-1}+ Mezza Rama *cv.* recorded the highest values in the traits of length pod 12.480 and 11.222cm and weight of 100 seed green 63.744 and 56.234g respectively during the two growth season and number seeds.pod^{-1} 8.281 and weight of green pod 9.922g during the first

growing season. In contrast, the interaction treatment sprayed 30 mg Zn.L^{-1} + Little Marvel *cv.* recorded the highest values in the trait of number pods.plant^{-1} 69.659 and 82.287 pod respectively during the two growth season.

Discussion

The superiority of zinc element spraying in yield characteristics and components may be due to the physiological role of this element in increasing vegetative growth (Tables 2, 3, 4, 5, 6 and 7) and the large vegetative population may have been caused by an increase in photosynthesis products, which have been reflected in increased structural processes within the plant that produces different compounds such as hormones that affect the process of division and increase the size of plant cells, also the abundance of photosynthesis products increases the activity of many biological processes such as pollination and reduces competition between seeds produced in pod on photosynthesis products, which are reflected as a final of increased yield and its components. Both El-Tohamy and El-Greadly (2007) and Garg *et al.,* (2008) report that increased vegetative growth leads to increased photosynthesis, which is reflected in increased dietary process products such as carbohydrates and proteins. Mohamed (2008) noted that the zinc element caused an increase in the volume of strawberry season due to increased plant production of the IAA compound. Both Marschner (1986) and Ebrahim *et al.,* (2011) noted that zinc component plays an important role activating the pollen, which was positively reflected in the increase in the number of zygote ovules.

This variation between the two pea varieties may be due to the genotype composition of each variety and its interaction with soil composition (Table 1) and climatic conditions, the superiority of the Mezza Rama *cv.* in most yield traits may be due to the nature of this variety by forming a large and dense root collection (see in the field) which enabled the plant to absorb a large proportion of nutrients more than the Little Marvel *cv.* (Tables 16, 17, 18, 19). In addition, the Mezza Rama *cv.* was higher in total vegetative volume (Table 6), which increased the efficiency of the process photosynthesis, which may have been reflected in the increase in production of food and hormonal compounds, which ultimately contributed to increase the yield components (length pod, number seeds.pod^{-1}, weight of green pod and weight of 100 seeds) and this increase of yield components of the Mezza Rama *cv.* reflected to increase plant yield and hectare of green seeds. As for the superiority of the Little Marvel *cv.* in the number pods.plant^{-1} may be due to the large number branches.plant^{-1} formed of this variety (Table 9), which is due to the nature of genetic composition. Hassan (2002) pointed out that there are many varieties of pea spread throughout the world and differ from each other in morphological traits because of the genetic makeup of these varieties and impact of environmental conditions on them.

Characteristics of qualitative and chemical:

The results of tables (15, 16, 17, 18 and 19) showed that two treatments of zinc spray at a concentration of 30 and 60 mg zn.L^{-1} on pea plants caused a significant increase in most qualitative and chemical traits during the two growth seasons . Significantly exceeded the spray treatment of 30 mg Zn .L^{-1} for pea plants on the treatment of spraying 60 mg Zn.L^{-1} on the pea plants in the traits of green seed content of protein, nitrogen and potassium by percentage reached respectively 15.59%, 17.59% and 6.54% for these traits during the first growth season, On the other hand, the spray treatment of 60 mg Zn.L^{-1} for pea plants was significantly higher on a spray treatment of 30 mg Zn.L^{-1} in the trait concentration of zinc in green seeds by percentage reached 14.46% during the first growth season . Results of tables (15, 16, 17, 18 and 19) showed that the control treatment recorded the lowest values of the qualitative and chemical qualities.

The results of the tables(15, 16, 17, 18 and 19) showed that the Mezza Rama *cv.* recorded the highest values for most of the qualitative and chemical traits during the two growth seasons, the Mezza Rama *cv.* was significantly

Table 14: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait yield of green seed per hectare (ton.Ha^{-1}) during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	7.528 b	8.856 a	9.182 a	8.522 a
Little Marvel	6.951 c	9.053 a	7.819 b	7.941 b
Average zinc	7.239 c	8.954 a	8.501 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	8.990 c d	10.396 b	11.199 a	10.195 a
Little Marvel	8.142 d	9.892 b c	9.383 c	9.139 a
Average zinc	8.566 b	10.144 a	10.291 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 15: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of protein ratio (%) in green seeds during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	12.883 b	15.230 a	12.819 b	13.644 a
Little Marvel	11.137 c	12.644 b	11.295 c	11.692 a
Average zinc	12.010 b	13.937 a	12.057 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	9.959 c d	12.201 a b	13.164 a	11.775 a
Little Marvel	9.643 d	11.186 b c	11.064 bcd	10.631 b
Average zinc	9.801 b	11.694 a	12.114 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 16: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of nitrogen concentration ratio (%) in green seeds during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	2.054 b	2.437 a	2.031 b	2.174 a
Little Marvel	1.793 b c	1.999 b c	1.741 c	1.844 a
Average zinc	1.924 b	2.218 a	1.886 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	1.558 c d	1.899 a b	2.024 a	1.827 a
Little Marvel	1.508 d	1.758 b c	1.718 b c d	1.661 a
Average zinc	1.871 a	1.828 a	12.114 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 17: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of phosphorus concentration ratio (%) in green seeds during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	0.5753 b	0.6577 a	0.6186 a b	0.6172 a
Little Marvel	0.5422 b	0.6071 a b	0.5577 b	0.5690 a
Average zinc	0.5587 b	0.6324 a	0.5881 a b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	0.2809 c	0.3576 a b	0.3622 a b	0.3336 a
Little Marvel	0.3410 b	0.3968 a	0.3662 a b	0.3680 a
Average zinc	0.3110 b	0.3772 a	0.3642 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

superior to the Little Marvel *cv.* in the trait of protein content of green seeds by percentage reached 10.78% during the second and the trait content of the potassium element in the green seeds by percentage reached 8.75 and 12.98% respectively during the two growth seasons. On the other hand, the Little Marvel *cv.* significantly exceeded the Mezza Rama *cv.* in the concentration of zinc in the green seeds by percentage reached 20.36% during the first season.

Results of the tables (15, 16, 17, 18 and 19) showed that the reaction treatment sprayed 30 mg Zn.L^{-1} + Mezza Rama *cv.* recorded the highest rate in the characteristics of protein ratio and concentration of N and K element in green seeds reached respectively 15.23%, 2.536% and 1.531% for these characteristics during the first growth season. While the reaction treatment sprayed 60 mg Zn.L^{-1} + Mezza Rama *cv.* recorded the highest percentage of protein 13.164% and nitrogen 2.024% in green seeds during the second growing season. In contrast, the reaction treatment sprayed 30 mg Zn.L^{-1} + Little Marvel *cv.* recorded the highest percentage of phosphorus 0.3986% in green seeds during the second growing season. While the reaction treatment sprayed 60 mg Zn.L^{-1} on the plants of Little Marvel *cv.* recorded the highest concentration of zinc element 45.685 (mg.Kg^{-1} dry matter) in green seeds during the first growing season.

Discussion

The superiority of the two treatments for spraying zinc on pea plants in the ratio of protein, nitrogen, phosphorus and potassium in green seeds (Tables 15, 16, 17 and 18) it may have been the final outcome to the increase of various biological processes (buildings) within the plant through the effect of the zinc element in increasing vegetative growth and chlorophyll (Table 3, 4 and 5), in addition, increase the root group size of the zinc treated plants (watch in the field) perhaps increased absorption of nutrients from the soil. AL-Naimy (1984) and Marschner (1986) they said that the zinc

Table 18: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of potassium concentration ratio (%) in green seeds during the two growth seasons 2012/2013 and 2013/2014.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	1.496 a	1.561 a	1.531 a	1.529 a
Little Marvel	1.307 b	1.535 a	1.375 b	1.406 b
Average zinc	1.402 b	1.548 a	1.453 b	
Second growth season 2013 / 2014				**Average cultivar**
Mezza Rama	1.381 b c	1.531 a	1.452 a b	1.454 a
Little Marvel	1.157 d	1.332 c	1.372 b c	1.287 b
Average zinc	1.269 b	1.432 a	1.412 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

Table 18: Effect of spraying leaves with the zinc element to plants two cultivars of pea and interaction between them in the trait of zinc concentration (mg.Kg^{-1} dry matter) in green seeds during the first growth season 2012/2013.

First growth season 2012 / 2013				
cultivars	**Concentrations of zinc element spraying (mg.l^{-1})**			**Average cultivar**
	Zero	**30**	**60**	
Mezza Rama	26.010 c	33.409 b	42.522 a	33.980 b
Little Marvel	33.356 b	43.655 a	45.685 a	40.898 a
Average zinc	29.683 c	38.532 b	44.103 a	

Means followed with the same latter are not significantly different according to Duncan multiple range test at the probability of 0.05 levels.

element contributes to the activation of tryptophan synthetase, which accelerates the interaction of compound serine and indole to be the amino acid tryptophan, who is responsible for the composition of IAA auxin which plays an important role in increasing the vegetative growth and roots of the plant. AL-Obeidy (2005) found that spraying the zinc element on the bean plants led to an increase in the plant roots size, which was reflected in the increase of the content of the nutrients N, P and K. AL-Musly (2013) said that the zinc element plays an important role in increasing the various biological processes within the plant, such as the process of nitrogen representation to form proteins, phosphorylation and starch formation. The increased conc. Zn in green seeds (Table 19) may be due to the increased conc. Zn in the Chelate fertilizer, which is sprayed on the leaves of plants, which was reflected as the final result of the increased concentration of this element in the seeds. Mady (2009) noted that the use of Zn as a spray on plant leaves facilitates the entry of this element into leaf cells without depositing this element on this walls of these cells.

The difference between the two pea varieties (Mezza Rama and Little Marvel) in the concentrations of protein, N, P, K and Zn in green seeds may be due to differences in genotype composition of these two cultivars (Hassan, 2002) and the extent of interaction of each genetic structure in soil condition (Table 1) and climate conditions. Perhaps the superiority of the Mezza Rama *cv.* is may be due to the nature of the growth of this cultivar, which is characterized by the large area of plant leaf (Table 3, 4) and the efficiency of chlorophyll in leaves (Table 5), which may have resulted in increased photosynthesis within the plant that is stored in the final seeds when they are formed.

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