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# INFLUENCE OF NITROPHENOLATES ON VEGETATIVE GROWTH AND REPRODUCTIVE COMPONENTS OF TWO PEA (*PISUM SATIVUM* L.) CULTIVARS

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**ABSTRACT**

This investigation was carried out during 4th November 2019 to 20th April 2020 at Grdarasha field, college of Agricultural Engineering Sciences-Salahaddin University, to evaluate the effect of foliar application of the Nitrophenolates biostimulator at different levels (0, 0.2, 0.4, 0.6, 0.8 and 1 ml.l$^{-1}$)on growth and yield of two Pea cultivars (Utrillo and Nihal). Significant results were obtained from most studied parameters. The results indicated that cultivars had significant response on some of vegetative growth and yield parameters of pea, the best results were recorded from Utrillo cultivar. Moreover, foliar spraying of Nitrphenolates had significant influence on vegetative parameters, the highest significant result of leaves and branchesnumber (110.747 and 2.694 respectively) were recorded from (1ml.l$^{-1}$). While, the best results of vegetative growth fresh weight and leaf chlorophyll content were obtained from 0.2 ml.l$^{-1}$treatment. Foliar spray of Nitrphenolate also increased significantly yield parameters, where the highest values of number of seeds.pod$^{-1}$, yield per plant, plat and hectare (6.000, 0.168kg, 1.009kg and 1.681ton respectively) were recorded from 0.2 ml.l$^{-1}$ treatment compared with the control. Meanwhile, there was the significant response of cultivars to foliar application of Nitrophenolates on most vegetative growth and yield components and were recorded for both cultivars especially Nihal.

***Keywords:*** Pea, Nitrophenolates, vegetative growth, yield, chlorophyll, protein

## INTRODUCTION

Peas *(Pisum sativum L.)* are a cool-season crop grown for their edible seed or seed pods. Different types of peas are grown for various purposes. Garden or green peas are harvested before the seed is mature for the fresh or fresh pack market (Elzebroek and Wind, 2008). Pea contain high nutritive value, green pods are rich in vitamins, protein and minerals (Ali *et al.,* 2016). The sugar snap pea (*Pisum sativum* L. var. macrocarpon Ser.) is considered suitable for cultivation, These edible pods are a highly regarded vegetable because of their sweet flavor (Myers *et al.,* 2001). Moreover, the sugar snap pea lacks the inner pod fiber and are also harvested early for the fresh or fresh-pack market (McGee, 2012).

Biostimulants are a category of relatively new products of diverse formulations that positively affect a plant's vital processesof plant growth and developments and whose impact is usually more evident under stressful conditions (Przybysz *et al.,* 2014). Nitrophenolates compounds have different commercial names like; Asahi, Atonic.

Djanaguiraman *et al.,* (2005) found in lab experiment that treatment of cotton and tomato seed with Atonikat 3mg/l gave best recording of germination, establishment and enzyme activity.

Abbas *et al.,* (2010) studied the effect of vernalization (5$^{0}$C for 5 days), Atonik (at 250, 500 and 1000 ml/l) and 6- denzyl adenine ( at 25, 50 and 100 ml/l) on growth and flowering parameters, photosynthesis pigment and some chemical contents of *Pisum sativum* L., the best treatment was vernalizational on or combination with Atonik (at 1000 ml/l) or with 6- denzyl adenine ( at 50 ml/l) significantly increased in root and shoot length, shoot fresh and dry weight, number of nodes/plant, number of leaves /plant, total leave narea/plant, relative water content and number of flower/ plant). Kwiatkowski and Juszczak (2011) observed that the application of growth stimulator (Asahi SL, Bio-algeen, Titanit) caused best quantitative characteristics of sweet basil including plant height, number of shoots and yield, and best weed control. Kocira *et al.,* (2015) indicated that single foliar spraying of plants with Asahi SL (0.1% and 0.3%) advantageously influenced on bean yield which increasing the number and the weight of seeds and the number of pods. Control, where biostimulator was not applied was characterized with the lowest results. Kocira *et al.,* (2017) mentioned to that the use of Atonik improved the yield and quality of red and white bean, the single and double spray of 0.1% and 0.3% solutions of Atonik biostimulant the yield increased, and the highest impact recorded from double spraying with the level of 0.3% solution. Moreover, all treatments had no significant effects on starch and protein contents. Single and double spraying of 0.1 and 0.2% of Atonic on bean (*Phaseolus vulgaris L.*) caused significant increasing seed yield, seed number, and 1000-seed weight over the control treatment (Szparaga *et al.,* 2019).

The aim of this study was to evaluate the effect of Nitrophenolates biostimulators on some vegetative growth and yield qualitative and quantitative traits of two pea cultivars.

## MATERIALS AND METHODS

This investigation was carried out during 4th November 2019 to 20th April 2020 at Grdarashafield to study the effect of foliar application at different levels on the growth and yield of two Pea cultivars (Utrillo and Nihal) were obtained from star seed company, turkey, with a rate of germination 98%. In 4th November the seeds was directly sown in the field. The physical and chemical properties of experiment shown in table (1). The meteorological condition during the experiment are shown in table (2).

### Preparation of Nitrophenolate solutions

Nitrophenolate solution is a chemical solution made by MFG company, and the chemical component of solution are 1g.l$^{-1}$ sodium 5-nitroguaiacolate ($NaC_7H_6NO_4$), 2g.l$^{-}$

**Table (1)** Physical and chemical properties of soil in the experiment site*

| Properties | Field Soil |
|---|---|
| pH | 7.65 |
| Electro Conductivity (EC) | 2.36 dS.m-1 |
| Organic matter | 1.134% |
| Total Nitrogen | 0.137% |
| Total Potassium | 0.440% |
| Total Phosphorus | 0.000558% |
| Total Iron (Fe) | 0.016% |
| Soil Texture | Silty Clay Loam |

* Central Laboratory of Collage of Agricultural Engineering Sciences.

**Table (2)** Meteorological data during experiment period*

| Month | Average temperature c$^{o}$ | | Average air humidity % | |
|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum |
| November | 10.73 | 23.39 | 20.57 | 49.99 |
| December | 7.96 | 16.42 | 46.58 | 82.16 |
| January | 5.20 | 13.14 | 45.62 | 82.97 |
| February | 6.05 | 14.09 | 42.23 | 81.59 |
| March | 10.70 | 20.54 | 38.50 | 77.00 |
| April | 13.01 | 24.80 | 32.24 | 75.01 |
| May | 18.84 | 33.95 | 15.70 | 49.71 |

* Ministry of Agriculture in Kurdistan region.

**Table (3)** Effect of Nitrophenolate concentrations on *Pisum sativum* L vegetative growth parameters

| Concentration (ml.l-1) | Plant length (cm) | No. of leaves. plant-1 | No. of branches. plant-1 | F. Wt. of Veg. gro. (kg.plant-1) | D. wt. of Veg. growth (kg.plant-1) | Chlorophyll content (spad) |
|---|---|---|---|---|---|---|
| 0.0 | 73.858a | 96.743b | 2.498a | 0.287c | 0.088b | 39.186bc |
| 0.2 | 64.942a | 95.997b | 2.694a | 0.424a | 0.070c | 42.553a |
| 0.4 | 65.775a | 108.970ab | 2.444a | 0.418a | 0.105a | 37.250c |
| 0.6 | 58.720a | 76.244c | 2.528a | 0.240c | 0.068c | 36.878c |
| 0.8 | 71.247a | 100.165ab | 2.167a | 0.366ab | 0.078bc | 33.658d |
| 1 | 61.220a | 110.747a | 2.500a | 0.309bc | 0.070c | 40.608ab |

*The same letters with the same column indicate non-significant differences from other according to DMRT at the 0.05 level.

**Table (4)** Effect of Nitrophenolate concentrations on *Pisum sativum* L. yield parameters

| Concentration (ml.l$^{-1}$) | No. of pod. plant$^{-1}$ | No. seed. pod$^{-1}$ | F.Wt of 100 seeds(g) | Yield.plot-1 (kg) | Yield. plant $^{-1}$ (kg) | Yield. ha $^{-1}$ (ton) | F.Wt of individual. pod (g) | D.Wt of individual. pod (g) |
|---|---|---|---|---|---|---|---|---|
| 0.0 | 79.500b | 5.332a | 52.592ab | 0.547c | 0.091c | 0.912c | 7.394a | 1.242b |
| 0.2 | 86.167b | 6.000a | 51.783ab | 1.009a | 0.168a | 1.681a | 8.617a | 1.512b |
| 0.4 | 116.667a | 5.500a | 53.808ab | 0.841b | 0.140b | 1.402b | 7.544a | 1.570b |
| 0.6 | 69.167b | 5.750a | 47.733b | 0.381d | 0.064d | 0.635d | 8.083a | 2.194a |
| 0.8 | 76.000b | 5.389a | 49.442b | 0.520c | 0.087c | 0.866c | 8.272a | 1.350b |
| 1 | 69.833b | 5.222a | 56.025a | 0.513c | 0.085c | 0.855c | 8.433a | 1.340b |

*The same letters with the same column indicate non-significant differences from other according to DMRT at the 0.05 level.

**Table (5)** Interaction effect of cultivars and concentration on *Pisum sativum* L vegetative parameters

| Cultivars | Concentration (ml.l-1) | Plant length (cm) | No. of leaves. plant-1 | No. of branches. plant-1 | F. Wt. of Veg. gro. (kg.plant-1) | D. wt. of Veg. gro. (kg.plant-1) | Chlorophyll content (spad) |
|---|---|---|---|---|---|---|---|
| Utrillo | 0.0 | 70.499a | 74.993de | 2.330a | 0.235de | 0.070def | 37.422cde |
| | 0.2 | 61.553a | 63.500e | 2.500a | 0.535a | 0.055f | 48.989a |
| | 0.4 | 69.997a | 83.500de | 2.444a | 0.575a | 0.130a | 35.066def |
| | 0.6 | 60.777a | 81.993de | 2.222a | 0.220d | 0.057ef | 34.333ef |
| | 0.8 | 73.887a | 86.500d | 2.222a | 0.430b | 0.100bc | 32.482f |
| | 1 | 68.887a | 77.415de | 2.889a | 0.353b | 0.070def | 38.067cde |
| Nihal | 0.0 | 77.217a | 118.493bc | 2.667a | 0.340bcd | 0.107b | 40.950bc |
| | 0.2 | 68.330a | 128.493abc | 2.889a | 0.313cde | 0.085bcd | 36.117bcd |
| | 0.4 | 61.553a | 134.440ab | 2.444a | 0.260cde | 0.080cde | 39.433def |
| | 0.6 | 56.663a | 70.495de | 2.833a | 0.260cde | 0.080cde | 39.422bcd |
| | 0.8 | 68.607a | 113.830c | 2.111a | 0.302cde | 0.057ef | 34.833def |
| | 1 | 53.553a | 144.080a | 2.111a | 0.265cde | 0.070def | 43.150b |

*The same letters with the same column indicate non-significant differences from other according to DMRT at the 0.05 level.



**Table (6)** Interaction effect of cultivars and concentration on *Pisum sativum* L yield parameters

| Cultivars | Concentration ($ml.l^{-1}$) | No. pod. $Plant^{-1}$ | No. seed. $pod^{-1}$ | F.Wt of 100 seed (g) | Yield.$plot^{-1}$ (kg) | Yield. $plant^{-1}$ (kg) | Yield. $ha^{-1}$ (ton) | F.Wt of individual. pod (g) | D.Wt of individual. pod (g) |
|---|---|---|---|---|---|---|---|---|---|
| Utrillo | 0.0 | 52.000e | 5.220a | 62.850a | 0.469c | 0.078c | 0.782c | 9.811a | 1.566bc |
| | 0.2 | 103.000abc | 5.889a | 57.867abc | 1.198a | 0.200a | 1.997a | 9.650a | 1.540bc |
| | 0.4 | 121.000a | 5.556a | 66.400a | 1.150a | 0.192a | 1.917a | 7.765abc | 1.716b |
| | 0.6 | 59.333de | 5.167a | 53.067bcd | 0.248d | 0.041d | 0.413d | 9.088ab | 2.829a |
| | 0.8 | 60.667de | 5.556a | 61.083ab | 0.529c | 0.088c | 0.882c | 9.878a | 1.500bc |
| | 1 | 48.000e | 5.556a | 62.100a | 0.470c | 0.078c | 0.783c | 9.867a | 1.348bcd |
| Nihal | 0.0 | 107.000ab | 5.444a | 42.333def | 0.625c | 0.104c | 1.042c | 4.977c | 0.918d |
| | 0.2 | 69.333cde | 6.111a | 42.700def | 0.820b | 0.137b | 1.366b | 7.584abc | 1.484bc |
| | 0.4 | 112.333ab | 5.444a | 41.217ef | 0.532c | 0.089c | 0.887c | 7.322abc | 1.425bc |
| | 0.6 | 79.000bcde | 6.333a | 42.400ef | 0.515c | 0.086c | 0.858c | 7.078abc | 1.558bc |
| | 0.8 | 91.333abcd | 5.222a | 37.800f | 0.510c | 0.085c | 0.850c | 6.667bc | 1.200cd |
| | 1 | 91.667abcd | 4.889a | 49.950cde | 0.556c | 0.093c | 0.927c | 7.000abc | 1.332bcd |

*The same letters with the same column indicate non-significant differences from other according to DMRT at the 0.05 level.

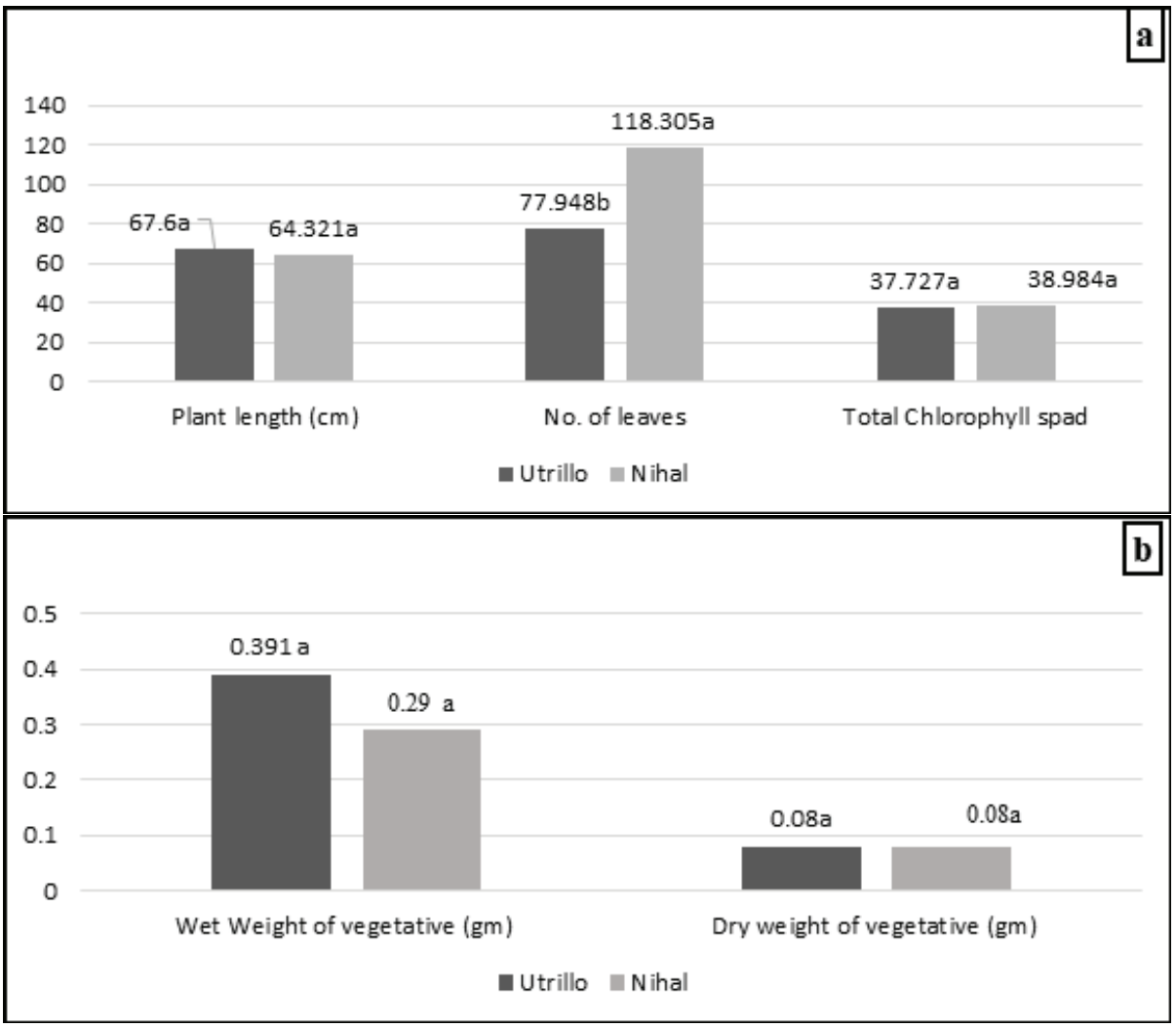


**Figure 1** a and b Response of Pisum sativum L. cultivars on vegetative growth parameters.
*(columns with the same letter are non-significant from each other according to DMRT at 0.05 level).

[1] sodium orthonitrophenolate ($NaC_6H_4NO_3$) and 3g.l$^{-1}$ sodium paranitrophenolate ($NaC_6H_4NO_3$), and The foliar application treatment at the levels (0.0, 0.2, 0.4, 0.6, 0.8 and 1.0 ml.l$^{-1}$ distil water) were prepared according to the treatments,(modified from Kocira *et al.,* (2017) and Szparaga *et al.,* (2019).

**Experimental design and statistical analysis**

The experiment was design as randomized complete block design (RCBD) with three replicates. The experiment consist 36 experiment unit, foliar application of plants with six concentration of Nitrophenolate (0.0, 0.2, 0.4, 0.6, 0.8 and 1.0 ml.l$^{-1}$ distil water) until run off and for thrice time during growing season started on 18/12/2019 with 15 days interval.

Finally, the data collected to analysis from experiment and the mean values were compared by Duncan's multiple range test at the level of 0.05.

**Experiment parameters**

At the end of the study, the data collected from all experiment units. The parameters were; plant height(cm), number of leaves, number of branches, fresh and dry weights of vegetative part. plant$^{-1}$ (kg). However, yield parameters include; number of pods. plant$^{-1}$, number of seed. pod$^{-1}$, fresh weight of individual pod, fresh weight of 100 seed (g), yield (kg), yield. ha$^{-1}$(ton), total chlorophyll (determined by using of portable SPAD 502 according to Incesu, 2015).

## RESULT AND DISCUSSION

**Vegetative growth parameters**

**Response cultivars**

Figure (1a) indicated that pea cultivars have significant effects on number of leaves. The best values of number of leaves was obtained from Nihal (118.305) where is no significant recorded from plant length and total chlorophyll. Figure (1b) illustrated that pea cultivars had no significant response on vegetative growth weight, its might be due to the variance in genotype characteristics of these two cultivars that affect on the absorption of nutrients and photosynthesis process and on the response to environmental conditions (Jordao*et al.,*1989 and Gaafar and Saker, 2006).

**Effect of Nitrophenolates**

Table (3) shows that foliar application cause significant effect on all vegetative parameter except plant height and number of branch. plant$^{-1}$. The best value of number of leaves. plant$^{-1}$(110.747) was recorded from 1 ml.l$^{-1}$of Nitrophenolate. However, the best value of dry weight

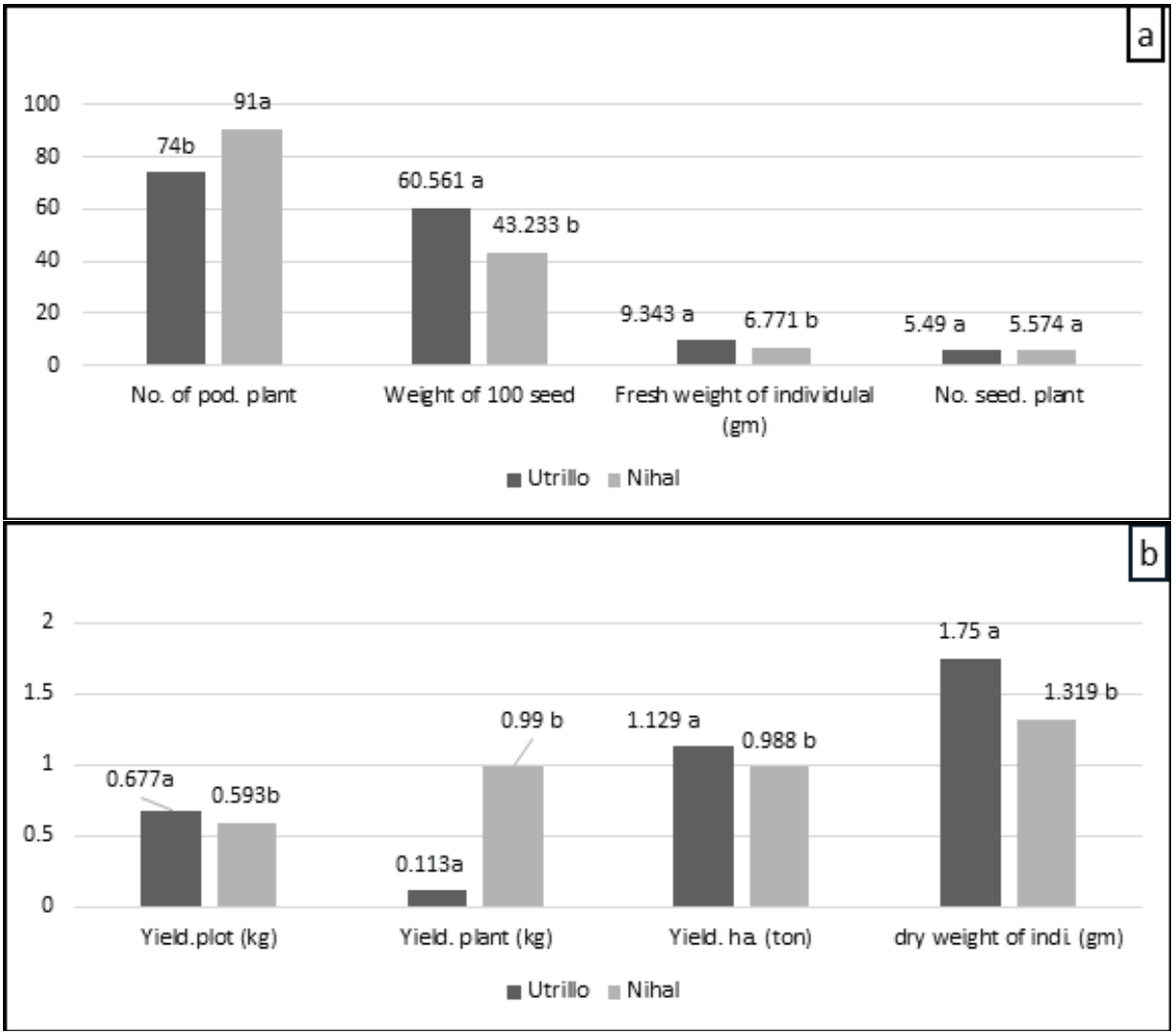


**Figure 2** a and b Response of *Pisum sativum* L. cultivars on yield parameters.
*(columns with the same letter are non-significant from each other according to DMRT at 0.05 levels).

of vegetative, (0.105kg) was recorded from 0.4ml.l$^{-1}$of Nitrophenolate. Moreover, the highest value of fresh weight of vegetative and chlorophyll content (0.424 and 42.553spad respectively) was obtained from 0.2 ml.l$^{-1}$of Nitrophenolate .Similar results was found by (al-jbury, 2002). Itcould be due to the syntheses of salicylic acid from sodium phenolate or directly from phenol, salicylic acid encourages growth and reduces growth inhibition (Shakirova *et al.,* 2003 and Xu *et al.,* 2011). Nitrophenolate compounds increase photosynthesis process in result increasing carbon dioxide absorption in plastid (Khan *et al.,* 2003) which cause producing of essential materials for new cell formation and increase plant vegetative growth (Singh and Usha, 2003).

**3-2 Yield components**

**1- Response of cultivars**

The figure (2a and b) shows that the statistical analysis of collected data of all yield parameters were responded significantly to foliar application of Nitrophenolates. The best value of weight of 100 seeds and fresh weight of individual pod, yield.plot$^{-1}$, yield.ha$^{-1}$, yield.plant$^{-1}$ and dry weight of individual pod (60.561, 9.343g, 0.677kg, 1.129ton, 1.75g) were recorded from Utrillo cultivar. Moreover, the best value of number of pod (91 and 0.99kg respectively) were obtained from Nihal cultivar. The results are harmony with Taain and Salman (2018) findings on egg plant. The differences in production could be due the differences among cultivars in their phenotypes and their interaction with environment which affected on the growth characteristics (Mohammed, 2013).

**Effect of Nitrophenolates**

The present result in table (4) indicated that number of pods.plant$^{-1}$, fresh weight of 100 seeds, yield.plot$^{-1}$(kg), yield.plant$^{-1}$(kg), yield.ha$^{-1}$(ton), dry weight of individual pod were significantly influenced by foliar application of Nitrophnolates at various concentrations. The best value of number of pod.plant$^{-1}$ (116.667) was recorded from 0.4 ml.l$^{-1}$ of Nitrophenolate. However, the highest value of weight of 100 seeds (56.025g) was obtained from 1ml.l$^{-1}$ of Nitrophenolate. Moreover, the best value of yield.plot$^{-1}$, yield.plant$^{-1}$, yield.ha$^{-1}$ (1.009 kg, 0.681kg and 1.681ton respectively) were recorded from 0.2ml.l$^{-1}$ of Nitrphenolate. The highest value of dry weight of individual pod (2.194g) was obtained from 0.6ml.l$^{-1}$ of Nitrophenolate. These results are agree with results of (Aksona and Aydın, 2019).Increasing yield parameter could be due to rising in the inner auxin concentration by exogenous application (Djanaguiraman *et al.,* 2005b).

**Interaction effect of cultivars and Nitrophenolate**

**Vegetative growth parameters**

Analysis of variation of the data showed that the foliar spray of Nitrophenolates on the two studied cultivars had significant effects on number of leaves, fresh and dry weights of vegetative growth and total chlorophyll content (Table 5). The best value of number of leaves (144.080) was obtained from Utrillo cultivar sprayed with 1ml.l$^{-1}$ of Nitrophenolate. However, the best value of fresh and dry weights of vegetative growth (0.575 and 0.130kg respectively) were recorded from Utrillo cultivar and 0.4ml.l$^{-1}$ of Nitrophenolate treatment. Moreover, the highest value of total chlorophyll (48.989 spad) was obtained from Utrillo cultivar and 0.2ml.l$^{-1}$ of Nitrophenolate. Our results are harmony with that obtained by (Abbas, 2009) in carrot plants. Nitrophenolates compounds like most of plant growth regulators that promote absorption nutrient element by plant that cause increase the cell division and number of leaves which inverse effect on growth and yield (Pandite *et al.,* 1982), these results might be due to the role of growth stimulators on increasing of chlorophyll construction and delay destruction in the plant (Wasfi, 1990).

**Yield components**

Results in table (6) indicate that significant increase of the means of all parameters except of number of seed. pot$^{-1}$. The best values of number of pod. plant-1 and fresh weight of 100 seeds (121.000 and 66.400 respectively) were recorded from Utrillo cultivar with 0.4ml.l$^{-1}$ of Nitrophenolate. Moreover, the highest values of yield. plot$^{-1}$, yield. plant$^{-1}$ and yield. ha$^{-1}$ (1.198kg, 0.200kg and 1997ton respectively) were obtained from Utrillo cultivars and 0. 2ml.l$^{-1}$ of Nitrophenolate. However, the best result of fresh weight of individual pod (9.878g) was recorded from Utrillo cultivars and 0.8ml.l$^{-1}$ of Nitrophenolate. Meanwhile, the best value of dry weight of individual pod (2.829g) was recorded from Utrillo cultivars and 0.6ml.l$^{-1}$ of Nitrophenolate. Results are agreement with the finding of (Obaid *et al.,* 2011 and AL-Jobori, 2010, Kocira, 2017). Increasing yield components could be due to the influence of biostimulator on increasing vegetative parameters which increase production of carbohydrate rate and translocated to the fruit (Al-Sahaf, *et al.,* 2011).

## CONCLUSION

According to the previous results it can be concluded that the application of Nitrophenolate had significant effect on growth and yield parameter:

1. The superior effect in yield parameters of Utrillo over Nihal cultivar was observed.

2-Foliar application with Nitrophenolate at concentration 0.2ml.l$^{-1}$ gave the best vegetative growth, yield and yield component parameters.

3. Interaction of Utrillo cultivar and foliar spray with Nitrophenolate positively affected on most vegetative growth characteristics and reproductive parameters.

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