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Effect of some Stimulants on Productivity of Pea (*Pisum sativum* L.) under High Temperature Stress Conditions

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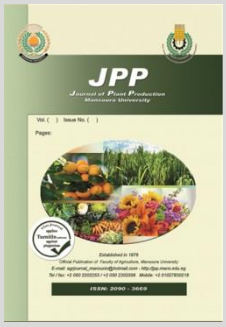

ABSTRACT

Two filed experiment were conducted at El- Baramoon Experimental Farm during 2016/2017 and 2017/2018 seasons to study effect of sowing dates and some growth stimulants on growth, yield and its component and seed quality of pea. The experiment was laid-out in a split-plot design with three replications. Sowing on 1st week of Sept. recorded the best results of plant height, number of leaves, fresh and dry weights of plant, N, P and K contents in leaves, pods number/plant, yield per plant and feddan than. Treated pea plants with NPK at 50 % of RR + humic acid + magnetic iron recorded highest values of plant height, number of leaves, total fresh and dry weights/plant, yield per plant fed in the both seasons and 100-seed weight in 2nd season. The N, P and K % in leaves were obtained with NPK at 50 % RR + humic acid + proline. Sowing on 1st week of Sept. and fertilizing with NPK at 50 % RR + humic acid + magnetic iron increased plant height, number of leaves, total fresh and dry weights/plant, yield per plant fed in both seasons and 100 seed weight in the 2nd season. While, sowing on 1st week of Feb. and spraying with proline amino increased proline content and oxides enzyme activity. Meanwhile, sowing on 1st week of Sept. and fertilizing with NPK at 50 % RR+ humic acid + proline gave the highest values of N, K and lowest values of proline content and oxides enzyme.

Keywords: Pea, Sowing dates, stimulants, foliar spraying, growth, productivity.

INTRODUCTION

Pea (*Pisum sativum* L.) is a member of the *Fabaceae* family and is regarded one of the most significant legume crops for local consumption and export as a common vegetable crop in Egypt. Because of its elevated protein content, ascorbic acid, carbohydrates, balanced amino acid structure and excellent digestibility, this crop is commonly used as a source of protein in human diets. In general, this crop gives high yield and ensures high profits, especially when cultivated for green pods.

Sowing date is one of the significant variables affecting productivity by increasing the timing and length of the vegetative and reproductive phases, as environmental variables such as temperature and light length vary with different sowing dates. Individual environmental components such as light and temperature have immediate impacts on procedures of physiology such as photosynthesis and breathing. It is therefore very essential to determine the optimum seeding date for pea which achieves the optimum boundaries for these variables in order to obtain the highest returns, (Mahmoud, 2008). Pea cultivation is widespread in areas having a mild and warm climate, because relatively high or low temperatures are the most important factors limiting pea cultivation. A dry climate is also unfit for the plant, especially during the growth of flowering and pods. The cumulative mean floral initiation temperature conditions varied and this information could be used to determine the sowing dates (Bozoglu *et al.*, 2007). Several workers found that early planting of pea significantly increased growth, yield and quality more than late planting (Tiwari *et al.*, 2014 ; Waheed *et al.*, 2015 and Sirwaiya and Kushwah, 2018).

Under Egyptian situation, there is a good need for further research to minimize the quantity of chemical NPK fertilizers in order to improve quality of vegetable crops and restrict environmental pollution. Many researchers indicated that increasing N, P and K fertilizers stimulated all morphological characteristics. In this connection, (Helmy, 2013; Lalito *et al.*, 2018 and Al-Bayati1 *et al.*, 2019) increasing N, P and K fertilizers gave the highest values of vegetative growth and yield of pea.

Humic substances can affect both respiration and photosynthesis (Nardi *et al.*, 2002). Treated pea plants with humic acid recorded the best results for enhancing growth, yield and quality (Khan *et al.* 2012 and Ramadan and Mansour 2019).

Magnetite (magnetic iron) is one of the most important factors affecting plant growth and yield and its components. Helmy (2013) showed that treated xspea plants with magnetic iron at 150 kg/fed improved yield and its components, *i.e.* pod length and diameter, number of seeds per pod, weight of 100 seeds, green pods yield per plant and per fed compared with untreated plants.

Royal jelly (RJ) is the Queen Honey Bee's exclusive food of (*Apis millifera*) larva (Viuda-Martos *et al.* 2008). RJ is mixed with saliva, hormones and vitamins from pollen, water and honey. It includes 65.3% water and 34.7% dry residue. The later is made up of proteins (48.2%), carbohydrates (37.8%), lipids (10.4%) and ash (2%). It also contains B_1, B_2, B_5, B_6, B_8, B_9 and C vitamins. It is also wealthy in minerals, in particular potassium, magnesium, calcium, iron, phosphorus, sulphur, manganese and silicon (El-Shaikh, 2010). Nassef and El-Aref (2016) on cucumber, reported that the highest number of fruits/plant, fruit length and diameter and total yield/fed were recorded with foliar application by Royal jelly at the rate of 2.4 g/L.

It is known that salicylic acid (SA) or ortho-hydroxy benzoic acid and other salicylates effect multiple plant

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physiological and biochemical operations and can play a main part in controlling their development and productivity (Hayat *et al*., 2010). In recent years, numerous studies have indicated that spraying salicylic acid increased plant growth and total yield of pea plants (El-Saadony *et al*., 2017 and Thomson *et al.*, 2017). Proline is the most important amino acids that accumulate in various tissues of the plant as a first physiological reaction when they are exposed to water stress. It is reported that proline has significant function in stabilizing osmotic effects by balancing of ion concentrations such as Na, K, Mg, and Ca in strengthening the cell wall and in other enzymatic actions (Iba, 2002). Gouda *et al*. (2015) on potato and El-Saadony *et al*. (2017) on pea, found that spraying plants with proline at 100 ppm gave the best growth and yield than unsprayed plants.

Therefore, the present study was planned to evaluate the suitable planting date and best stimulants under various levels of mineral fertilizers to obtain the high plant growth and maximum yield with best quality of pea plants under the environmental conditions of Dakhalia Governorate, Egypt.

MATERIALS AND METHODS

Two filed experiments were conducted at El-Baramoon Experimental Farm, Dakhalia Governorate, Egypt, during 2016/2017 and 2017/2018 seasons to study the effect of sowing dates and some growth stimulants on growth, yield and its component and seed quality of green pods and quality of pea Master B cultivar.

In both seasons of study, random soil samples were taken from the experimental field area at a depth of 0- 30 cm from soil surface before soil preparation to estimate the physical and chemical soil properties according to Page *et al.* (1982) as shown in Table 1. Also the local metrological data during 2016, 2017 and 2018 are presented in Table 2.

Table 1. The physical and chemical properties* during both seasons of the experimental soil.

Soil analysis	1st season (2016/2017)	2nd season (2017/2018)
Physical properties		
Sand (%)	12.21	13.90
Silt (%)	37.58	35.9
Clay (%)	44.74	45.20
Texture	Silty clay loam	Silty clay loam
Chemical properties		
Soil reaction (pH) in 2.5 soil suspension	8.0	8.0
EC (dSm^{-1})	1.31	1.17
OM (%)	1.59	1.72
Available N (ppm)	38.0	37.0
Available P (ppm)	8.3	9.2
Exchangeable K (ppm)	451	462

*Soil and Water Analysis Institute, Mansoura Lab., Agricultural Research Center (ARC).

Table 2. The local meteorological data (Tempurature "C°" and Relative Humidity "RH %") during 2016, 2017 and 2018 prevailing at El-Mansoura region.

Months	2016 season				2017 season				2018 season			
	Temp (C°)		RH (%)		Temp (C°)		RH (%)		Temp (C°)		RH (%)	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Jan.	---	---	----	--	18.9	13.6	89.4	65.4	18.9	13.6	89.4	64.4
Feb.	--	--	--	-----	21.6	14.6	87.6	63.4	21.6	14.6	87.6	63.4
Mar.	--	---	---	-----	25.4	16.6	82.3	48.3	25.	16.6	82.3	48.3
April	---	---	---	----	27.8	20.	80.9	43.9	27.8	20	80.9	43.9
May	----	---	--	---	31.2	23.8	75.6	43.9	31.2	23.8	75.6	43.9
Sep.	32.6	24.3	83.1	51.8	32.8	23.5	83.1	48.3	--	--	--	--
Oct.	29.8	21.7	82.4	55.3	28.7	24	81.0	54.7	--	--	--	--
Nov.	24.9	17.9	77.9	56.8	23.7	19.9	84.7	58.6	--	--	--	--
Dec.	19.3	10.8	85.4	65.1	21.5	18.4	88.2	64.8	--	--	--	--

The field experiment was laid-out in a split-plot design with three replications. The experiment included sixty treatments comprising, two sowing dates and thirty stimulants treatments.

The main-plots were assigned to two sowing dates (first week of September and February) in each season.

The sub-plots were allocated with the following thirty stimulants treatments:

1. NPK at 50 % of the recommended rate (RR).
2. Humic acid (10 kg /fed.).
3. Magnetic iron (100 kg /fed.).
4. NPK at 50 % RR + magnetic iron.
5. NPK at 50 % RR + humic acid.
6. Humic acid+ magnetic iron
7. NPK at 50 % RR + humic acid+ Magnetic iron.
8. Royal gel (5000 ppm).
9. Salicylic acid (70 ppm).
10. Proline amino acid (25 ppm).
11. NPK at 50 % RR + royal gel.
12. NPK at 50 % RR + salicylic acid.
13. NPK at 50 % RR + proline.
14. Magnetic iron + royal gel.
15. Magnetic iron + salicylic acid.
16. Magnetic iron + proline.
17. Humic acid + royal gel.
18. Humic acid + salicylic acid.
19. Humic acid + proline.
20. NPK at 50 % RR + magnetic iron + proline.
21. NPK at 50 % RR+ magnetic iron + salicylic acid.
22. NPK at 50 % RR+ magnetic iron + royal gel.
23. Magnetic iron + humic acid + salicylic acid.
24. Magnetic iron + humic acid + proline.
25. Magnetic iron + humic acid + royal gel.
26. NPK at 50 % RR+ humic acid + royal gel.
27. NPK at 50 % RR+ humic acid + salicylic acid.
28. NPK at 50 % RR+ humic acid + proline.
29. Humic acid RR+ salicylic acid + royal gel.
30. NPK at 100 % RR (control treatment).

The plants which fertilized with NPK as follows; 100 % recommended doses equal; 200 kg ammonium nitrate (33.5 % N)/fad, 200 kg calcium superphosphate (15.5 % P_2O_5)/fad and 100 kg potassium sulphate (48 % K_2O)/fed One - third of NPK doses were added at soil preparation. The other two thirds were added after 30 and 60 days after sowing.

Humic acid and Magnetic iron were added at soil preparation. The plants were sprayed with Royal gel, Salicylic acid and proline amino acid, three times at 21, 36 and 51 days after sowing. The foliar treatments were sprayed by hand sprayer (for experimental plots) until saturation point.

Before sowing, seeds of pea Master B cultivar were successively washed and inoculated with root nodule bacteria (*Rhizobium leguminosarum*). The adhesive agent used was Arabic gum 20%. The inoculated seeds were left in a shaded place for one hour before sowing for air- drying.

The seeds were sown in hills (two seeds/hill) at 10 cm apart on both sides of the ridge. Plot area was 12 m^2, it contains four ridges (5 m length and 0.6 m width).

Data recorded:

Samples of ten plants from each experimental unit were randomly taken at 55 days after sowing, and the following data were recorded. Plant height (cm), number of leaves/plant, fresh weight (g/plant) and dry weight (g/plant).

2- Chemical analyses:

- Proline content was determined in dry leaves after 55 days from sowing in the 2nd season only according to the method described by Bates (1973).
- Oxides enzyme activity (mg/g FW/1hour). It was determined in leaves at 55 days after sowing in the 2nd season only according to (Loukili *et al*., 1999).
- Nitrogen, phosphorus and potassium contents in leaves at 55 days after sowing in both seasons according to the methods described by Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970), respectively.

3- Yield and its components:

Green pods of each sub-plot were harvested at maturity stage, counted and weighed in each harvest and the following parameters were determined; average number of pods/plant,seed index(100-seed weight) (g), individual plant yield and total yield/fed.

Statistical analysis:

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split-plot design as published by Gomez and Gomez (1984) by using "MSTAT-C" computer software package. Means of treatments were compared using Duncan's multiple range tests at 5 % level of probability as described by Duncan (1955).

RESULTS AND DISCUSSION

Plant Growth:

1. Effect of sowing dates:

There were significant differences between the two sowing dates (1st week of September and February) of pea cv. Master B regarding plant height, number of leaves, total fresh weight and total dry weight / plant of pea in both seasons (Table 3). Sowing pea on 1stweek of Sept. gave higher values of vegetative growth characters than sowing on 1st week of Feb. in both seasons. The increases in total dry weight / plant were about 38.30 and 36.57 % for sowing pea on the 1st week of Sept. over than sowing on the 1st week of Feb. in the 1st and the 2nd seasons, respectively. The higher plant growth of pea sown in September as compared with the February could be attributed to favourable climatic conditions in general and temperature in particular (Thongam *et al*. 2017).

Table 3. Effect of sowing dates and some stimulant treatments on plant height, number of leaves/plant, fresh weight and dry weight of pea plant during 2016/2017 and 2017/2018 seasons.

Characters	Plant height (cm)		Number of leaves/plant		Total fresh weight/plant		Total dry weight/plant	
Treatments	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Effect of sowing date								
1st Sept	44.66 a	49.91 a	28.09 a	29.59 a	18.57 a	19.68 a	6.21 a	6.61 a
1st Feb.	35.13 b	39.37 b	23.78 b	25.27 b	15.76 b	17.11 b	4.49 b	4.84 b
Effect of stimulants								
T_1	34.95 i	36.54 r	25.96 gh	21.62 n	15.41m	17.31 jk	5.05 gi	5.33 fg
T_2	38.58 f	43.49 m	27.53 ce	28.44dg	18.36 ce	18.96dg	5.70 be	5.90 be
T_3	44.58 cd	45.51 jl	27.86 be	26.44 ik	17.63 hi	18.57 fh	5.51 de	5.77 bf
T_4	41.82 e	45.79 ik	27.96 bd	28.62 cf	18.64 bc	19.08 bf	5.81 bd	5.95 be
T_5	44.18 d	47.56 df	27.25 de	27.77 fh	18.16 dg	18.51 fh	5.67 be	5.74 bf
T_6	39.33 f	45.59 jk	23.92 ik	25.89 k	15.95 l	17.26 jk	4.96 gi	5.37 fg
T_7	51.92 a	52.26 a	31.29 a	32.19 a	20.86 a	21.46 a	6.48 a	6.66 a
T_8	35.66 gi	38.04 q	22.58 lm	22.95 m	13.72 o	14.63 m	4.18 k	4.53 i
T_9	35.24 hi	36.69 r	23.12 km	24.30 l	15.41 m	15.87 l	5.06 gi	5.05 gh
T_{10}	24.25 k	27.34 s	22.17 m	22.90 m	14.78 n	15.27 lm	4.61 j	4.76 hi
T_{11}	41.35 e	49.67 b	26.85 dg	27.79 fh	17.90 fh	18.52 fh	5.57 ce	5.76 bf
T_{12}	41.89 e	46.87 fh	27.16 df	28.56 cf	18.11 eg	19.04 cf	5.66 be	5.94 be
T_{13}	36.65 gh	43.00 mn	24.03 ik	25.64 k	16.02 l	17.09 k	5.00 gi	5.33 fg
T_{14}	36.45 gh	48.24 cd	24.24 ik	29.52 bc	16.16 kl	19.68 bd	5.04 gi	6.12 bc
T_{15}	41.34 e	50.03 b	28.98 b	28.24 eg	18.83 b	19.32 be	5.86 bc	6.00 bd
T_{16}	32.78 j	42.74 mn	24.20 ik	25.61 k	16.13 l	17.08 k	5.02 gi	5.32 fg
T_{17}	42.08 e	47.96 ce	24.42 ij	26.30 jk	16.28 jl	17.53 ik	5.10 gh	5.46 eg
T_{18}	38.69 f	44.92 kl	27.90 bd	28.66 bf	18.60 bd	19.11 bf	5.77 bd	5.96 be
T_{19}	47.81 b	44.65 l	27.89 bd	29.33 bd	17.51 hi	19.56 bd	5.81 bd	6.08 bd
T_{20}	45.72 c	41.06 p	27.34 ce	29.10 be	18.22 cg	19.40 bd	5.69 be	6.03 bd
T_{21}	38.47 f	48.62 c	23.91 ik	27.45 gi	15.94 l	18.30 gh	4.96 gi	5.71 bf
T_{22}	41.56 e	49.60 b	26.68 eg	29.34 bd	17.78 gi	19.56 bd	5.53 de	6.08 bd
T_{23}	35.60 gi	41.73 op	23.37 jl	26.96 hj	16.58 jk	17.97 hj	4.86 hj	5.60 df
T_{24}	36.09 gi	46.14 hj	24.96 hi	29.55 bc	17.64 hi	19.70 bc	5.19 fg	6.14 b
T_{25}	42.24 e	42.28 no	24.91 hi	27.65 fh	16.61 j	18.43 fh	5.17 fg	5.76 bf
T_{26}	36.89 g	47.84 ce	23.09 km	29.50 bc	15.39 m	19.66 bd	4.79 ij	6.11 bc
T_{27}	45.43 cd	47.14 eg	26.05 fh	27.11 hj	17.37 i	18.07 hi	5.41 ef	5.63 cf
T_{28}	38.58 f	43.44 m	26.70 eg	27.81 fh	17.80 gi	18.54 fh	5.55 de	5.80 bf
T_{29}	41.82 e	46.48 gi	27.43 ce	27.97 fh	18.29 cf	18.64 eh	5.67 be	5.77 bf
T_{30}	44.82 cd	47.99 ce	28.46 bc	29.68 b	18.97 b	19.78 b	5.90 b	6.15 b

T_1: 50 % NPK of the recommended | **T_7=T_1+T_2+T_3** | **T_{13}= T_1+T_{10}** | **T_{19}= T_2+T_{10}** | **T_{25}= T_3+T_2+T_8**

T_2 Humic acid | **T_8= Royal gel** | **T_{14}= T_3+T_8** | **T_{20}= T_1+T_3+T_{10}** | **T_{26}= T_1+T_2+T_8**

T_3:Magnetic iron | **T_9= Salicylic acid** | **T_{15}= T_3+T_9** | **T_{21}= T_1+T_3+T_9** | **T_{27}= T_1+T_2+T_9**

T_4 = T1+T3 | **T_{10}= Proline amino acid** | **T_{16}= T_3+T_{10}** | **T_{22}= T_1+T_3+T_8** | **T_{28}= T_1+T_2+T_{10}**

T_5 = T1 +T_2 | **T_{11}= T_1+T_8** | **T_{17}= T_2+T_8** | **T_{23}= T_3+T_2+T_9** | **T_{29}= T_2+T_9+T_8**

T_6= T2+T3 | **T_{12}= T_1+T_9** | **T_{18}= T_2+T_9** | **T_{24}= T_3+T_2+T_{10}** | **T_{30}= 100 % NPK**

Such increases in the studied morphological character during the early sowing period may be due to the appropriate and common metrological variables specific to temperature and relative humidity (Table 2), which have a positive effect

on plant growth. Also, the appropriate prevailing temperature resulting in an rise in the rate of photosynthetic assimilation and an increase in the length of the plant growth cycle. Such findings can be due to the appropriate temperature during germination and vegetative development, which led to increase in growth rate of plants and resulting in photosynthetic assimilation rate rising (Abou El-Yazied, 2011). These results are harmony with those reported by Sharma *et al.* 2014 and Waheed *et al.* (2015) on pea.

2. Effect of stimulants:

The obtained results in Table 3 show that fertilizing pea plants with NPK at 50 % RR + humic acid + magnetic iron (T_7) increased plant height, number of leaves ,total fresh weight/ plant and total dry weight/ plant, followed by fertilizing with humic acid+ spraying with proline (T_{14}) or (T_{19}) in both seasons, while sprayed with proline (T_{10}) decreased the above mentioned traits in both seasons. The increases in total dry weight / plant due to T_7 were about 9.83 and 8.29% over the plants which fertilized with NPK at 100 % RR (T_{30}) in the 1st and the 2nd seasons, respectively.

These results were in agreement with those obtained by Al-Bayati *et al.* (2019) for NPK, Ramadan and Mansour (2019) for humic acid and Helmy (2013) for magnetic iron.

3. Effect of the interaction:

The interaction between sowing date and some stimulant treatments had significant effect on all pea growth characters in both seasons (Tables 4 and 5). The interaction between first sowing date (1st week of Sept.) and T7 (NPK at 50 % RR + humic acid + magnetic iron) . (T_7) increased plant height, number of leaves, total fresh weight/ plant and total dry weight/ plant in the both seasons followed by the interaction between sowing date on the 1st week of Sept. and T_{17} (humic acid + spraying with proline) in the 2016 /2017 season and sowing at 1st week of Sept. and T_{14} (magnetic iron + spraying with Royl gel) in the 2017/2018 season.

The increases in total dry weight / plant were 41.84 and 41.33 % due to the interaction between sowing pea plants on the 1st week of Sept. and treated with T_7 over the interaction between sowing pea plants on Feb. and fertilizing with T_{30} in the 1st and 2nd seasons, respectively.

Table 4. Effect of the interaction between sowing dates and some stimulant treatments on plant height, number of leaves/plant, fresh weight and dry weight of pea plant during the first season (2016/2017).

Characters / Treatments	Plant height (cm)		Number of leaves/plant		Total fresh weight/plant		Total dry weight/plant	
	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.
T_1	40.61 jm	29.29 xz	28.37fh	23.55 tx	16.47 qv	14.36/ab	6.00 gj	4.10 ya
T_2	41.38 hk	35.79 qr	28.69 eg	26.38 io	19.13df	17.59 jn	6.38 eg	5.03 pr
T_3	54.50 a	34.67 rs	29.81 bf	25.91jp	20.13 bc	15.13 yz	6.71 be	4.32 vz
T_4	47.41cd	36.24 or	30.60 bc	25.32ks	20.40 b	16.88 or	6.80 bd	4.82 qu
T_5	50.05 b	38.32 no	30.42 bd	24.08rv	20.28 b	16.05 tx	6.76 be	4.59 sw
T_6	43.25 fh	35.42 r	25.45 ks	22.40wy	16.97 nr	14.93 ya	5.66 jm	4.27 wz
T_7	53.54 a	50.31 b	32.47 a	30.12 be	21.65 a	20.08 bc	7.22 a	5.74 im
T_8	40.55 jm	30.78 uy	24.86mu	20.30 -ab	15.91 ux	11.53 /e	5.00 ps	3.37 /b
T_9	41.65 gj	28.83 yz	24.70 ou	21.54 ya	16.47 qv	14.36 /ab	5.36 mp	4.76 qu
T_{10}	27.88 z	20.63 -a	24.62 pu	19.73 -b	16.41 rw	13.15 -d	5.47 lo	3.76 /ab
T_{11}	44.88 ef	37.82 nq	28.96cg	24.75nu	19.31 de	16.50 qu	6.44 cf	4.71 rv
T_{12}	47.85 c	35.94 pr	30.47 bd	23.86rx	20.31 b	15.91 ux	6.77 be	4.55 tw
T_{13}	43.50 fg	29.80 wz	26.44 in	21.62 ya	17.63 jm	14.41 /ab	5.88 hl	4.12 xa
T_{14}	42.19 gj	30.72 uy	26.86 hk	21.62ya	17.91 ij	14.41 -ab	5.97 gj	4.12 xa
T_{15}	50.05 b	32.64 su	30.42 bd	27.55 gj	20.53 b	17.13 lp	6.84 ac	4.89 qt
T_{16}	34.23 rt	31.34 ux	25.83 jq	22.57vy	17.22 kp	15.05 yz	5.74 im	4.30 vz
T_{17}	44.70 ef	39.47 kn	28.26 fh	20.59zb	18.84eg	13.73 /cd	6.28fh	3.92 za
T_{18}	42.58 gj	34.81 r	28.87 d	26.94hk	19.25de	17.96 hj	6.42 df	5.13 nq
T_{19}	53.54 a	42.08gj	31.12 ab	24.66 pu	18.59 fh	16.44 qv	6.92 ab	4.70 rv
T_{20}	48.61 bc	42.84 fi	30.56 bc	24.12 qv	20.37 b	16.08 sx	6.79 be	4.59 sw
T_{21}	41.50 gk	35.45 r	25.56 kr	22.26 xz	17.04 mq	14.84 za	5.68 jm	4.24 wz
T_{22}	47.80 c	35.33 r	28.31 fh	25.05 lt	18.87eg	16.70 ps	6.29fh	4.77 qu
T_{23}	40.94 il	30.27 vy	26.07 ip	20.68zb	17.38 jo	15.79 wx	5.79 il	3.94 za
T_{24}	40.78 im	31.40uw	27.66 gi	22.26 xz	18.44 gi	16.84 or	6.15 fi	4.24 wz
T_{25}	45.64 de	38.84 ln	26.53 im	23.30ux	17.69 jl	15.53 xy	5.90 hk	4.44 uy
T_{26}	41.50 gk	32.28 tv	24.90mu	21.28 yb	16.60 pt	14.19 / bc	5.53kn	4.05 ya
T_{27}	52.94 a	37.92 np	28.31 fh	23.80sx	18.87 eg	15.87 vx	6.29fh	4.53 tx
T_{28}	42.46 gj	34.71 rs	29.43 cf	23.97 rw	19.62 cd	15.98 tx	6.54 bf	4.57 sw
T_{29}	44.93ef	38.71 mn	28.22 fh	26.65 hl	18.81eg	17.77 jk	6.27 fh	5.08 or
T_{30}	48.38 bc	41.26 hk	30.19 be	26.73hk	20.13 bc	17.82 ik	6.71 be	5.09 or

T_1: 50 % NPK of the recommended
T_2 Humic acid
T_3:Magnetic iron
T_4 = T1+T3
T_5 = T1 +T_2
T_6= T2+T3
T_7=T_1+T_2+T_3
T_8= Royal gel
T_9= Salicylic acid
T_{10}= Proline amino acid
T_{11}= T_1+T_8
T_{12}= T_1+T_9
T_{13}= T_1+T_{10}
T_{14}= T_3+T_8
T_{15}= T_3+T_9
T_{16}= T_3+T_{10}
T_{17}= T_2+T_8
T_{18}= T_2+T_9
T_{19}= T_2+T_{10}
T_{20}= T_1+T_3+T_{10}
T_{21}= T_1+T_3+T_9
T_{22}= T_1+T_3+T_8
T_{23}= T_3+T_2+T_9
T_{24}= T_3+T_2+T_{10}
T_{25}= T_3+T_2+T_8
T_{26}= T_1+T_2+T_8
T_{27}= T_1+T_2+T_9
T_{28}= T_1+T_2+T_{10}
T_{29}= T_2+T_9+T_8
T_{30}= 100 % NPK

Biochemical traits:

1. Effect of sowing dates:

The effect of sowing date on leaves biochemical traits , i.e., proline content and oxides enzyme activity during 2017/2018 season are shown in Table (6). Sowing date on the 1st week of Feb. increased proline content and oxides enzyme activity in leaves compared with sowing on the 1st week of Sept. in the 2nd season. The increases in proline content and oxides activity due to sowing on the 1st week of Feb. were 10.97 and 16.51 %, respectively over sowing on the 1st week of September.

The rise in proline amino acid in crops cultivated at elevated temperatures could be one of the earliest metabolic reactions caused in the transduction pathway that connects physiological perception reactions at the cellular level. (Hassanein *et al.*, 2012). These results are similar to Naji and Devaraj (2011) who found that peroxidase isozyme activity in horse gram increase under heat and salt stresses.

Table 5. Effect of the interaction between sowing dates and some stimulant treatments on plant height, number of leaves/plant, fresh weight and dry weight of pea plant during the first season (2017/2018).

Characters	Plant height (cm)		Number of leaves/plant		Total fresh weight/plant		Total dry weight/plant	
Treatments	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.
T_1	41.91st	31.18 ab	21.70 yz	21.54 yz	16.25sv	18.37 ko	6.42 ch	4.25 ps
T_2	46.95mn	40.03 uv	30.51cg	26.38 nr	20.34 cg	17.59 nr	6.78 ag	5.03 lo
T_3	50.33 gj	40.70 tv	30.19 dg	22.70 xy	19.87 ei	17.27 ps	6.62 bh	4.93 lp
T_4	51.08 fi	40.50 uv	31.45bd	25.79 ps	20.97 bd	17.19 qs	6.99 ae	4.91 lp
T_5	51.71 ef	43.41 qr	28.64 hk	26.90 lp	19.09 hk	17.93 lq	6.36 ch	5.12 lo
T_6	49.94 hj	41.24 tu	27.66 kn	24.12 ux	18.44 kn	16.08tw	6.15 gi	4.59 ms
T_7	56.56 a	47.96 lm	33.41 a	30.98 bf	22.27 a	20.65 bf	7.42 a	5.90 hk
T_8	40.51 uv	35.58y	24.96 rv	20.95 z	15.97 tw	13.30 x	5.07 lo	4.00 rs
T_9	42.90 qs	30.48 b	25.64 pt	22.97xy	15.09 w	16.65 ru	6.00 hj	4.10 qs
T_{10}	30.78 b	23.91 c	25.27 qu	20.54 z	16.85 qt	13.69 x	5.62 il	3.91 s
T_{11}	56.56 a	42.79 qs	29.58fi	26.00 os	19.72 fi	17.33 os	6.57 bh	4.95 lp
T_{12}	49.84 ik	43.90 pq	31.30 be	25.83 ps	20.87 be	17.22 qs	6.96 ae	4.92 lp
T_{13}	49.85 ik	36.16 y	27.94jm	23.34 wx	18.63 jn	15.56 vw	6.21 fi	4.45os
T_{14}	55.94 ab	40.55 uv	31.54bd	27.51 kn	21.03 bc	18.34 ko	7.01 ad	5.24 kn
T_{15}	55.28 bc	44.78 op	30.80 cf	25.69 ps	20.28 cg	18.37 ko	6.76 ag	5.25 km
T_{16}	46.85mn	38.63wx	27.76 kn	23.47 vx	18.51 jn	15.65 uw	6.17 gi	4.47 os
T_{17}	52.29 ef	43.64 pr	28.46 hk	24.15 tx	18.97 hl	16.10 tw	6.32di	4.60 ms
T_{18}	51.49eg	38.35 x	31.50 bd	25.83 ps	21.00 bc	17.22 qs	7.00 ae	4.92 lp
T_{19}	54.26 cd	35.05 y	31.12 be	27.55 kn	20.75 bf	18.37 ko	6.92 af	5.25 km
T_{20}	48.65 kl	33.48 z	30.75cg	27.46 ko	20.50 cg	18.31 kp	6.83 ag	5.23 kn
T_{21}	54.26cd	42.99 qs	30.24 dg	24.66 sw	20.16 cg	16.44 sv	6.72 ag	4.70 mr
T_{22}	53.95d	45.26 o	31.17 be	27.51 kn	20.78 be	18.34 ko	6.93 ae	5.24 kn
T_{23}	51.13 fh	32.33 za	29.90 eh	24.02 ux	19.93 dh	16.01 tw	6.64 bh	4.57 ms
T_{24}	52.59 e	39.69 vw	32.38 ab	26.73 mq	21.59 ab	17.82 mq	7.20 ab	5.09 lo
T_{25}	49.46 jk	35.11 y	31.50 bd	23.80 ux	21.00 bc	15.87 tw	7.00 ae	4.53 ns
T_{26}	49.99 hj	45.70 no	31.41 bd	27.59 kn	20.94 bd	18.39 kn	6.98 ae	5.25 km
T_{27}	51.65 ef	42.63 rs	29.30 gj	24.93 rv	19.53 gj	16.62 ru	6.51 bh	4.75 mq
T_{28}	51.26 fg	35.62 y	31.54 bd	24.08 ux	21.03 bc	16.05 tw	7.01 ad	4.59 ms
T_{29}	47.19 m	45.77 no	28.31 il	27.63 kn	18.87 im	18.42 kn	6.29 ei	5.26 jm
T_{30}	52.20 ef	43.78 pr	31.77 bc	27.59 kn	21.18 bc	18.39 kn	7.06 ac	5.25 km

T_1: 50 % NPK of the recommended — **T_7=T_1+T_2+T_3** — **T_{13}= T_1+T_{10}** — **T_{19}= T_2+T_{10}** — **T_{25}= T_3+T_2+T_8**

T_2 Humic acid — **T_8= Royal gel** — **T_{14}= T_3+T_8** — **T_{20}= T_1+T_3+T_{10}** — **T_{26}= T_1+T_2+T_8**

T_3:Magnetic iron — **T_9= Salicylic acid** — **T_{15}= T_3+T_9** — **T_{21}= T_1+T_3+T_9** — **T_{27}= T_1+T_2+T_9**

T_4 = T1+T3 — **T_{10}= Proline amino acid** — **T_{16}= T_3+T_{10}** — **T_{22}= T_1+T_3+T_8** — **T_{28}= T_1+T_2+T_{10}**

T_5 = T1 +T_2 — **T_{11}= T_1+T_8** — **T_{17}= T_2+T_8** — **T_{23}= T_3+T_2+T_9** — **T_{29}= T_2+T_9+T_8**

T_6=T2+T3 — **T_{12}= T_1+T_9** — **T_{18}= T_2+T_9** — **T_{24}= T_3+T_2+T_{10}** — **T_{30}= 100 % NPK**

2. Effect of stimulants:

Proline amino acids and oxides enzyme activity in leaves of pea had significant effects by different treatments during 2nd season (Table 6). Spraying pea plants with proline (T_{10}) gave the highest values of proline content (18.49 ppm) and oxides enzyme activity (27.68 mg/g FW/1hour) in leaves , followed by the plants which fertilized with humic acid (T_2) (17.98 ppm) and 26.56 mg/g FW/1hour) proline content and oxides enzyme activity , respectively. On the other side, the lowest values of proline content (8.51 ppm) was obtained with of NPK at 50 % RR + humic acid + Royal gel (T_{26}) and oxides enzyme activity (8.01 mg/g FW/1hour) with NPK at 50 %RR + Humic acid + Proline (T_{28}). The plants which fertilized with NPK at 100 % RR (T_{30}) recorded the moderate values of proline content and oxides enzyme activity between them.

3. Effect of interaction:

The interaction between sowing date and some stimulants had significant effect on proline content and oxides enzyme activity in leaves of pea during 2017/2018 season (Table 7). The interaction between sowing date on the 1st week of Feb and spraying with proline (T_{10}) increased proline content (19.32 mg/g DW) and oxides enzyme activity (29.05 mg/g FW/1hour) in leaves of pea compared with the other interaction treatments in the 2nd season. On the other hand, T_{26} and T_{28} under early sowing (1st week of Sept.) gave the minimum contents of proline amino acid (7.35 ppm) and oxides enzyme (7.18 mg/g FW/1hour), respectively.

N, P and K Contents IN leaves:

1. Effect of sowing dates:

Data given in Table 8 indicate the effect of sowing date on N,P and K contents in shoots during 2016/2017 and 2017/2018seasons. Sowing date on the 1st week of Sept. increased N,P and K contents in leave compared to sowing date on the 1st week of Feb. in both seasons. The increases in NP and K in leaves/ plant due to sowing pea on the 1st week of Sept. were about 16.20 , 24.66 % and 29.92 , 26.33 % and 15.67 and 16.32 for N,P and K in the 1st and the 2nd seasons, respectively over sowing on the 1st week of February.

Such effect of the sowing date on N, P and K contents was linked to the plant vegetative growth response to the sowing date. The variations in NPK concentration in leave between the tested sowing date may be due to the prevailing temperature during the separate sowing date (Table (2)) affecting the absorption of nutrients and their migration to distinct morphological components. Abd-Alla (2006) on snap bean found that early sowing on 1st of March led to significant increases in N,P and K contents in plant foliage compared with either medium (1st April) or late (1st May) plantation.

2. Effect of stimulants:

Data in Table (8) illustrate the effect of some stimulants on shoots chemical composition, i.e., N, P and K percentages during 2016/2017 and 2017/2018 seasons. Fertilizing pea with NPK at 50 % RR + humic acid+ spraying with proline (T_{28}) had significant effect and recorded the highest value of N, P and K contents in leave in

both seasons, with no significant differences with spraying with salicylic acid (T_9) with respect to P content. The increases in N,P and K in leave / plant due to T_{28} were about (17.39 and 20.86 % N), (3.36 and 3.57 % P) and (5.66 and 11.76 % K) over fertilizing with NPK 100 % RR (T_{30}) in the 1st and the 2nd seasons, respectively.

Table 6. Effect of sowing dates and some stimulant treatments on proline content and oxides enzyme activity in leaves of pea as an averages of both season.

Characters / Treatments	Proline content (mg/g DW)	Oxides enzyme activity (mg/g FW/1 hour)
Effect of sowing date		
1st Sept	12.85 b	16.05 b
1st Feb.	14.26 a	18.70 a
Effect of stimulants		
T_1	15.79 fg	22.98 g
T_2	17.98 b	26.56 b
T_3	16.81 e	24.33 e
T_4	12.90 m	16.58 p
T_5	12.17 o	15.70 r
T_6	13.27 l	17.23 o
T_7	9.58 t	10.86 y
T_8	17.25 d	25.06 d
T_9	17.65 c	25.80 c
T_{10}	18.49 a	27.68 a
T_{11}	12.54 n	16.32 q
T_{12}	13.63 k	17.98 n
T_{13}	13.71 k	15.11 s
T_{14}	15.79 fg	22.24 h
T_{15}	15.14 i	20.82 j
T_{16}	15.37 hi	19.40 l
T_{17}	15.47 gh	21.54 i
T_{18}	14.78 j	20.13 k
T_{19}	16.00 f	18.69 m
T_{20}	9.95 s	11.55 x
T_{21}	10.29 r	12.24 w
T_{22}	11.22 pq	10.13 z
T_{23}	11.01 q	13.71 u
T_{24}	11.39 p	14.39 t
T_{25}	12.76 mn	12.98 v
T_{26}	8.51 v	8.73 b
T_{27}	8.86 u	9.40 a
T_{28}	10.15 rs	8.01 c
T_{29}	18.32 a	23.63 f
T_{30}	9.92 s	11.53 x

T_1: 50 % NPK of the recommended
T_2 Humic acid
T_3:Magnetic iron
T_4 = T1+T3
T_5 = T1 +T_2
T_6=T2+T3
T_{19}= T_2+T_{10}
T_{20}= T_1+T_3+T_{10}
T_{21}= T_1+T_3+T_9
T_{22}= T_1+T_3+T_8
T_{23}= T_3+T_2+T_9
T_{24}= T_3+T_2+T_{10}
T_7=T_1+T_2+T_3
T_8= Royal gel
T_9= Salicylic acid
T_{10}= Proline amino acid
T_{11}= T_1+T_8
T_{12}= T_1+T_9
T_{25}= T_3+T_2+T_8
T_{26}= T_1+T_2+T_8
T_{27}= T_1+T_2+T_9
T_{28}= T_1+T_2+T_{10}
T_{29}= T_2+T_9+T_8
T_{30}= 100 % NPK
T_{13}= T_1+T_{10}
T_{14}= T_3+T_8
T_{15}= T_3+T_9
T_{16}= T_3+T_{10}
T_{17}= T_2+T_8
T_{18}= T_2+T_9

These results coincide with those reported by Ramadan and Mansour (2019) on pea as for the effect of humic. As for proline effect Kahlaoui *et al.* (2013) indicated that spraying tomato plants with proline amino acid at the lower concentration (10 mg/ l) increased K and P contents in different organs compared with control treatment.

3. Effect of the interaction:

It is clear from such data that leave chemical composition, i.e., N, P and K percentages were significantly affected by the interaction between sowing date and treated with some stimulants in both seasons (Tables 9 and 10). The interaction between sowing date on the 1st week of Sept. and spraying with salicylic acid (T_9) increased P content in leave, whereas the interaction between sowing date on the 1st week of Sept. and fertilizing with NPK at 50 % RR + humic acid+ spraying with proline (T_{28}) increased N and K contents in shoots in both seasons. On the other hand, the interaction between sowing date on the 1st week of Feb. and fertilizing plants with humic acid (T_2) decreased N, P and K contents in shoots in both seasons.

Table 7. Effect of the interaction between sowing dates and some stimulant treatments on proline content and oxides enzyme activity in leaves of pea as an averages of both seasons.

Characters / Treatments	Proline content (mg/g DW)		Oxides enzyme activity (mg/g FW/1hour)	
	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.
T_1	15.18 op	16.41 ik	21.27 l	24.70 g
T_2	17.93 cd	18.04 c	24.81 g	28.32 b
T_3	16.60 hj	17.02 gh	22.57 j	26.10 e
T_4	12.18 ya	13.63 uv	14.95 x	18.21 p
T_5	11.39 ce	12.96 wx	14.62 y	16.78 s
T_6	12.57 xy	13.97 su	15.57 v	18.90 o
T_7	8.53 /l	10.63 /fg	10.02 /k	11.71 /f
T_8	17.15 fg	17.35 eg	23.30 i	26.82 d
T_9	17.52 df	17.79 ce	24.03 h	27.58 c
T_{10}	17.66 ce	19.32 a	26.32 e	29.05 a
T_{11}	11.80 /ac	13.28 vw	15.19 wx	17.45 r
T_{12}	12.96 wx	14.30 rs	16.34 t	19.62 n
T_{13}	12.80 x	14.63 qr	14.23 z	15.99 u
T_{14}	15.42 np	16.17 jl	20.52 m	23.96 h
T_{15}	14.63 qr	15.65 mo	19.16 o	22.48 j
T_{16}	14.99 pq	15.76 ln	17.75 q	21.06 l
T_{17}	14.98 pq	15.97 km	19.84 n	23.25 i
T_{18}	14.24 rt	15.32 np	18.46 p	21.80 k
T_{19}	15.37 np	16.64 hi	17.04 s	20.34 m
T_{20}	8.92 /kl	10.98 /ef	10.66 /i	12.45 /d
T_{21}	9.27 / jk	11.31 /de	11.40 /g	13.09 /c
T_{22}	10.14 /hi	12.31 yz	9.23 /m	11.03 /h
T_{23}	10.09 /hi	11.94 zb	12.82 /c	14.60 y
T_{24}	10.50 /gh	12.29 yz	13.49 /b	15.29 w
T_{25}	11.68 /bd	13.84 tu	12.06 /e	13.91 /a
T_{26}	7.35 /m	9.67 /ij	7.91 /p	9.55 /l
T_{27}	7.74 /m	9.98 /i	8.51 /o	10.30 /j
T_{28}	8.97 /kl	11.34 /ce	7.18 /q	8.84 /n
T_{29}	17.97 cd	18.68 b	21.88 k	25.39 f
T_{30}	9.22 /jk	10.62 /fg	10.55 /ij	12.52 /d

T_1: 50 % NPK of the recommended
T_2 Humic acid
T_3:Magnetic iron
T_4 = T1+T3
T_5 = T1 +T_2
T_6=T2+T3
T_{19}= T_2+T_{10}
T_{20}= T_1+T_3+T_{10}
T_{21}= T_1+T_3+T_9
T_{22}= T_1+T_3+T_8
T_{23}= T_3+T_2+T_9
T_{24}= T_3+T_2+T_{10}
T_7=T_1+T_2+T_3
T_8= Royal gel
T_9= Salicylic acid
T_{10}= Proline amino acid
T_{11}= T_1+T_8
T_{12}= T_1+T_9
T_{25}= T_3+T_2+T_8
T_{26}= T_1+T_2+T_8
T_{27}= T_1+T_2+T_9
T_{28}= T_1+T_2+T_{10}
T_{29}= T_2+T_9+T_8
T_{30}= 100 % NPK
T_{13}= T_1+T_{10}
T_{14}= T_3+T_8
T_{15}= T_3+T_9
T_{16}= T_3+T_{10}
T_{17}= T_2+T_8
T_{18}= T_2+T_9

Yield and its components:

1. Effect of sowing dates:

The effect of sowing date on pod number / plant weight of 100 seeds and green pod yield per plant, as well as green pod yield per fed of pea plants during 2016/2017 and 2017/2018 seasons are shown in (Table 11). Results show that there were significant differences between two sowing date on yield and its components in both seasons.

Sowing date of pea cv. Master B on the 1st week of Sept. recorded the highest values of number of pods/ plant, 100 seed weight (g), green pod yield per plant and per fed. compared with sowing date of 1st of Feb. in both seasons. The increases in total yield / fed. were about 17.91 and 16.89% for sowing date of pea on the 1st week of Sept. over than sowing date on the 1st week of Feb. in the 1st and the 2nd seasons, respectively.

Table 8. Effect of sowing dates and some stimulant treatments on nitrogen, phosphorus and potassium contents in leaves of pea during 2016/2017 and 2017/2018 seasons.

Characters	N (%)		P (%)		K (%)	
Treatments	**2016/2017**	**2017/2018**	**2016/2017**	**2017/2018**	**2016/2017**	**2017/2018**
Effect of sowing date						
1st Sept	3.37 a	3.74 a	0.411 a	0.427 a	1.55 a	1.71 a
1st Feb.	2.90 b	3.00 b	0.329 b	0.338 b	1.34 b	1.47 b
Effect of stimulants						
T_1	2.99 lm	3.22 s	0.331 pq	0.335 o	1.32 oq	1.42 q
T_2	2.89 no	3.13 u	0.315 t	0.317 q	1.25 r	1.35 s
T_3	2.94 mn	3.22 st	0.328 qr	0.330 p	1.26 qr	1.39 r
T_4	3.20 ef	3.45 fh	0.374 j	0.415 cd	1.47 hk	1.58 kl
T_5	3.25 ce	3.49 de	0.385 h	0.393 gi	1.50 fi	1.60 jk
T_6	3.18 fh	3.43 gi	0.369 k	0.372 j	1.45 il	1.56 lm
T_7	3.11 ij	3.48 ef	0.415 cd	0.419 c	1.62 ac	1.74 c
T_8	2.92 n	3.21 st	0.325 s	0.331 op	1.34 np	1.43 pq
T_9	2.90 no	3.18 t	0.384 h	0.395 gh	1.26 qr	1.36 s
T_{10}	3.02 l	3.24 rs	0.334 p	0.335 o	1.31 pr	1.45 op
T_{11}	3.23 df	3.47 eg	0.378 i	0.397 fg	1.49 fj	1.66 gh
T_{12}	3.18 fg	3.41 hl	0.369 k	0.374 j	1.43 jm	1.59 kl
T_{13}	3.28 cd	3.51 ce	0.386 h	0.390 i	1.51eh	1.63 ij
T_{14}	2.99 lm	3.34 np	0.342 o	0.344 n	1.35 np	1.46 o
T_{15}	3.08 jk	3.33 op	0.346 n	0.349 lm	1.38 mo	1.53 n
T_{16}	3.11 ij	3.36 mo	0.352 m	0.357 k	1.38 mo	1.53 n
T_{17}	3.04 kl	3.30 pq	0.341 o	0.346 mn	1.36 np	1.47 o
T_{18}	3.09 ik	3.28 qr	0.348 n	0.351 l	1.39 ln	1.52 n
T_{19}	3.13 gj	3.38 jm	0.356 l	0.361 k	1.42 km	1.59 kl
T_{20}	3.14 gi	3.40 im	0.327 rs	0.416 c	1.48 gk	1.70 de
T_{21}	3.09 ik	3.38 kn	0.405 e	0.411 de	1.47 gk	1.69 ef
T_{22}	3.12 hj	3.42 hk	0.412 d	0.418 c	1.52 eh	1.72 cd
T_{23}	3.27 cd	3.54 bc	0.395 f	0.401 f	1.55 df	1.66 fgh
T_{24}	3.30 bc	3.37 ln	0.390 g	0.392 hi	1.53 dg	1.64 hi
T_{25}	3.35 b	3.42 hj	0.397 f	0.409 e	1.56 ce	1.68 eg
T_{26}	3.48 a	3.56 ab	0.427 a	0.429 a	1.65 ab	1.78 b
T_{27}	3.46 a	3.53 bcd	0.421 b	0.424 b	1.64 ab	1.79 b
T_{28}	3.51 a	3.59 a	0.430 a	0.434 a	1.68 a	1.90 a
T_{29}	2.85 o	3.01 v	0.315 t	0.417 c	1.25 r	1.55 mn
T_{30}	2.99 lm	3.49 ef	0.416 c	0.419 c	1.59 bd	1.70 de

T_1: 50 % NPK of the recommended
T_2 Humic acid
T_3:Magnetic iron
T_4 = T1+T3
T_5 = T1 +T_2
T_6= T2+T3
T_7=T_1+T_2+T_3
T_8= Royal gel
T_9= Salicylic acid
T_{10}= Proline amino acid
T_{11}= T_1+T_8
T_{12}= T_1+T_9
T_{13}= T_1+T_{10}
T_{14}= T_3+T_8
T_{15}= T_3+T_9
T_{16}= T_3+T_{10}
T_{17}= T_2+T_8
T_{18}= T_2+T_9
T_{19}= T_2+T_{10}
T_{20}= T_1+T_3+T_{10}
T_{21}= T_1+T_3+T_9
T_{22}= T_1+T_3+T_8
T_{23}= T_3+T_2+T_9
T_{24}= T_3+T_2+T_{10}
T_{25}= T_3+T_2+T_8
T_{26}= T_1+T_2+T_8
T_{27}= T_1+T_2+T_9
T_{28}= T_1+T_2+T_{10}
T_{29}= T_2+T_9+T_8
T_{30}= 100 % NPK

The increments in total yield during early sowing date may be due to the suitable prevalent metrological factors specially temperature (Table 2) which affect positively and increased the vegetative growth phase of plant. Also, such suitable metrological factors increased macronutrients absorption (Table 8) and in turn increased total yield/ plant and total yield per fed). Whereas the late sowing date led to the decrease of all tested morphological characteristics owing to the lowest prevailing temperature during the vegetative development stage, which increased the use of assimilated materials in the breath and subsequently decreased the anabolic rate of fresh plant components and decreased the development of plants (Ali, 2011).

Similar results were reported by Sharma *et al.* (2014), Tiwari *et al.* (2014), Waheed *et al.* (2015) and Sirwaiya and Kushwah (2018) on pea,where they found that sowing on early date showed maximum yield and its components than delaying sowing of pea.

2. Effect of stimulants:

The obtained results in Table 11 show that , fertilizing plants with NPK at 50 % RR + magnetic iron +humic acid (T_7) increased average pods number / plant, 100 seeds weight, green yield /plant and green yield / fed. in both seasons, with no significant differences with fertilizing with NPK at 100 % and 50 % RR (T_{30} and T_1) with respect to pod number/ plant in the 1st and 2nd seasons, respectively. The increases in total yield / fed. due to T_7 were about 8.93 and 2.34 % over fertilizing with NPK at 100 % RR (T_{30}) in the 1st and the 2nd seasons, respectively.

These results were in the same line with those showed by Lalito, *et al.* (2018) and Al-Bayati *et al.* (2019) respecting the response of pea plants to NPK fertilizer. Khan *et al.*(2012) and Ramadan and Mansour (2019) regarding the effect of humic acid on pea, and magnetic iron, Helmy (2013) on pea.

3. Effect of the interaction:

Data presented in Tables 12 and 13 the interaction between sowing date and some stimulants reflected significant effect on yield and its components in the two growing both seasons. The interaction between sowing pea on early date (1st week of Sept) and treated with all treatments recorded the best results for yield and its components than that delaying date (1st week of Feb.) and treated with the same treatments in both seasons. The interaction between sowing date on the 1st week of Sep. and fertilizing with NPK at 50 % RR (T_1) in the 1st season and NPK at 100 % RR (T_{30}) in the 2nd season increased number of pod/ plant, whereas the interaction between sowing plants on the 1st week of Sept. and fertilizing with NPK at 50 % RR+ magnetic iron + humic acid (T_7) increased 100 seed weight in the 2nd season and yield /plant and total yield /fed. in both seasons. The increases in total yield/fed. due to T_7 were about 33.64 and 27.63 % over T_{30} under late sowing and 12.36 and 4.18 % over T_{30} under the early sowing in the 1st and 2nd seasons, respectively.

Table 9. Effect of the interaction between sowing dates and some stimulant treatments on nitrogen, phosphours and potassium contents in leaves of pea during the first season (2016/2017).

Characters	N (%)		P (%)		K (%)	
Treatments	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.
T_1	3.24kl	2.75 /ad	0.37qs	0.291/f	1.41rw	1.23/cf
T_2	3.14mp	2.64 /ef	0.351vw	0.279/h	1.36vz	1.15 /f
T_3	3.18ln	2.71 /be	0.371qrs	0.286/g	1.36vz	1.17/ef
T_4	3.47eg	2.94 /uw	0.415 j	0.334xy	1.57hm	1.37uy
T_5	3.52 cf	2.99 sv	0.422 hi	0.349vw	1.60fk	1.40sx
T_6	3.44 fh	2.92 vx	0.409 k	0.330y	1.55jn	1.35vz
T_7	3.07 ps	3.16 lo	0.457 d	0.373qr	1.73ad	1.51 lq
T_8	3.16 lo	2.69 /cf	0.364 t	0.286/g	1.49mr	1.19/df
T_9	3.14 mp	2.67 /df	0.490 a	0.279/h	1.36vz	1.17/ef
T_{10}	3.30 jk	2.74 /ad	0.374 pq	0.294/ef	1.41rw	1.22/cf
T_{11}	3.49 df	2.98 tv	0.420 i	0.336x	1.59gl	1.39tx
T_{12}	3.46 fg	2.91 vx	0.407 k	0.331y	1.54 jo	1.33 wb
T_{13}	3.55 be	3.02 qu	0.425 gh	0.348w	1.62ej	1.41rw
T_{14}	3.20 lm	2.78 zb	0.383 mn	0.301/cd	1.45pu	1.25/be
T_{15}	3.35 ij	2.81 ya	0.385 mn	0.307/ab	1.48ns	1.28zc
T_{16}	3.37 hj	2.86 wz	0.387 m	0.318z	1.51lq	1.25/be
T_{17}	3.29 jk	2.79 zb	0.382 no	0.301/cd	1.46ot	1.26/a
T_{18}	3.34 ij	2.85 xz	0.386 mn	0.311/a	1.50mq	1.29yc
T_{19}	3.39 gi	2.88 wy	0.396 l	0.317 z	1.53 kp	1.32xb
T_{20}	3.19 lm	3.10 nq	0.349 vw	0.305/bc	1.62ej	1.35vz
T_{21}	3.18 ln	3.01 ru	0.448 e	0.363tu	1.59gl	1.36vz
T_{22}	3.20 lm	3.05 qt	0.456 d	0.369 rs	1.68 bf	1.37 uy
T_{23}	3.60 bc	2.94 uw	0.437 f	0.353 v	1.65 dh	1.45 pu
T_{24}	3.57 bd	3.04 qt	0.428 g	0.352 vw	1.64 ei	1.43 qv
T_{25}	3.62 b	3.09 or	0.436 f	0.359 u	1.67 cg	1.46 ot
T_{26}	3.77 a	3.20 lm	0.471 b	0.384 mn	1.76 ab	1.55 jn
T_{27}	3.75 a	3.17 lo	0.464 c	0.378 op	1.75 ac	1.53kp
T_{28}	3.81 a	3.22 km	0.474 b	0.387 m	1.80 a	1.56 in
T_{29}	3.09 or	2.61 /f	0.334 xy	0.297 /de	1.34 wa	1.17 /ef
T_{30}	3.22 km	2.76 /ac	0.466 c	0.367 st	1.70 be	1.49 mr

T_1: 50 % NPK of the recommended
T_2 Humic acid
T_3:Magnetic iron
T_4 = T1+T3
T_5 = T1 +T_2
T_6=T2+T3
T_7=T_1+T_2+T_3
T_8= Royal gel
T_9= Salicylic acid
T_{10}= Proline amino acid
T_{11}= T_1+T_8
T_{12}= T_1+T_9
T_{13}= T_1+T_{10}
T_{14}= T_3+T_8
T_{15}= T_3+T_9
T_{16}= T_3+T_{10}
T_{17}= T_2+T_8
T_{18}= T_2+T_9
T_{19}= T_2+T_{10}
T_{20}= T_1+T_3+T_{10}
T_{21}= T_1+T_3+T_9
T_{22}= T_1+T_3+T_8
T_{23}= T_3+T_2+T_9
T_{24}= T_3+T_2+T_{10}
T_{25}= T_3+T_2+T_8
T_{26}= T_1+T_2+T_8
T_{27}= T_1+T_2+T_9
T_{28}= T_1+T_2+T_{10}
T_{29}= T_2+T_9+T_8
T_{30}= 100 % NPK

Table 10. Effect of the interaction between sowing dates and some stimulant treatments on nitrogen, phosphours and potassium contents in leaves of pea during the second season (2017/2018).

Characters	N (%)		P (%)		K (%)	
Treatments	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.
T_1	3.69 il	3.03 uw	0.376 p	0.294 /de	1.53 ps	1.32 /ef
T_2	3.59 n	3.08 su	0.353 v	0.282 /f	1.46 vx	1.24 /h
T_3	3.65 kn	3.00 vx	0.372 pr	0.288 /ef	1.50 sv	1.29 /fg
T_4	3.87 ce	3.24 op	0.486 b	0.344 wx	1.69 jk	1.47 ux
T_5	3.91ac	2.78 /c	0.432 j	0.354 uv	1.72 ij	1.49 sv
T_6	3.86 ce	2.75 /c	0.413 k	0.331 y	1.67 kl	1.46 vx
T_7	3.72 ij	2.81 /bc	0.462 fg	0.376 p	1.85 cd	1.63 lm
T_8	3.64 ln	3.04 tv	0.369 qs	0.294 /de	1.48 tw	1.39 zb
T_9	3.61 mn	2.98 vy	0.495 a	0.296 /d	1.47 ux	1.25 /gh
T_{10}	3.68 jl	3.08 su	0.375 pq	0.296 /d	1.58 no	1.33 /df
T_{11}	3.90 bc	2.97 wz	0.453 hi	0.342 x	1.80 eg	1.52 qt
T_{12}	3.85 cf	2.91 za	0.416 k	0.333 y	1.75 hi	1.43 xz
T_{13}	3.94 ab	2.94 xz	0.430 j	0.350 vw	1.75 hi	1.51 ru
T_{14}	3.71 ik	2.87 /ab	0.384 no	0.304 /c	1.59 mo	1.34 /ce
T_{15}	3.75 gi	2.93 ya	0.388 mo	0.310 /bc	1.69 jk	1.37 /ad
T_{16}	3.79 fh	2.96 xz	0.394 lm	0.320 za	1.67 kl	1.40 ya
T_{17}	3.73 hj	3.13 qs	0.388 mo	0.305 /c	1.59 mo	1.35 /be
T_{18}	3.64 ln	3.11 rs	0.389 mo	0.314 /ab	1.67 kl	1.38 /ac
T_{19}	3.81 eg	3.15 qr	0.399 l	0.324 z	1.74 hi	1.44 wy
T_{20}	3.67 jm	3.12 rs	0.466 df	0.367 rs	1.82 df	1.59 mo
T_{21}	3.65 kn	3.10 rt	0.458 gh	0.364 st	1.81 dg	1.57 np
T_{22}	3.69 il	3.15 qr	0.466 df	0.370 ps	1.84 de	1.61 mn
T_{23}	3.97 a	3.27 o	0.448 i	0.355 uv	1.78 fh	1.55 or
T_{24}	3.65 kn	3.25 op	0.431 j	0.353 v	1.75 hi	1.53 ps
T_{25}	3.70 il	3.30 o	0.458 gh	0.360 tu	1.81 dg	1.56 oq
T_{26}	3.86 ce	2.75 /c	0.472 cd	0.387 no	1.89 bc	1.67 kl
T_{27}	3.82 df	3.19 pq	0.465 ef	0.383 o	1.92 b	1.67 kl
T_{28}	3.88 bd	3.03 uw	0.478 c	0.390 mn	2.03 a	1.77 gh
T_{29}	3.27 o	3.08 su	0.447 i	0.387 no	1.67 kl	1.43 xz
T_{30}	3.79 fh	3.00 vx	0.469 de	0.369 qs	1.82 df	1.59 mo

T_1: 50 % NPK of the recommended
T_2 Humic acid
T_3:Magnetic iron
T_4 = T1+T3
T_5 = T1 +T_2
T_6=T2+T3
T_7=T_1+T_2+T_3
T_8= Royal gel
T_9= Salicylic acid
T_{10}= Proline amino acid
T_{11}= T_1+T_8
T_{12}= T_1+T_9
T_{13}= T_1+T_{10}
T_{14}= T_3+T_8
T_{15}= T_3+T_9
T_{16}= T_3+T_{10}
T_{17}= T_2+T_8
T_{18}= T_2+T_9
T_{19}= T_2+T_{10}
T_{20}= T_1+T_3+T_{10}
T_{21}= T_1+T_3+T_9
T_{22}= T_1+T_3+T_8
T_{23}= T_3+T_2+T_9
T_{24}= T_3+T_2+T_{10}
T_{25}= T_3+T_2+T_8
T_{26}= T_1+T_2+T_8
T_{27}= T_1+T_2+T_9
T_{28}= T_1+T_2+T_{10}
T_{29}= T_2+T_9+T_8
T_{30}= 100 % NPK

Table 11. Effect of sowing dates and some stimulant treatments on yield and its components of pea during 2016/2017 and 2017/2018 seasons.

Characters	Pod number/plant		100-seed weight (g)		Yield/plant (g)		Total yield (t/fed)	
Treatments	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
				Effect of sowing date				
1st Sept	5.99 a	6.45 a	44.80 a	48.59 a	36.63 a	41.13 a	4.396 a	4.939 a
1st Feb.	5.51 b	5.94 b	37.63 b	42.03 b	31.07 b	35.21 b	3.728 b	4.225 b
				Effect of stimulants				
T_1	6.37 a	6.82 a	29.32 q	24.54 q	35.74 f	38.69 j	4.289 e	4.663 hj
T_2	5.22 mn	5.88 o	37.56 o	44.63 k	31.26 p	37.13 n	3.751 lm	4.455 m
T_3	5.61 k	6.59 c	47.62 b	48.96 c	33.19 j	39.71 h	3.982 g	4.765 eg
T_4	5.40 l	5.76 q	38.81 m	42.59 o	32.28 n	35.46 q	3.874 ik	4.272 op
T_5	6.39 a	6.60 c	44.54 e	49.02 c	37.13 d	40.81 d	4.455 cd	4.898 d
T_6	6.12 bd	6.45f	43.85 f	47.73 e	36.52 e	39.78 gh	4.383 d	4.773 eg
T_7	6.22 b	6.55cd	49.00 a	53.01 a	40.73 a	44.08 a	4.888 a	5.290 a
T_8	4.20 p	4.72 r	42.91 g	46.67 gh	20.46 r	24.42 s	2.455 o	2.931 r
T_9	5.31 lm	5.82 p	37.39 o	41.14 p	27.19 q	37.08 n	3.263 n	4.449 m
T_{10}	5.02 o	6.47ef	39.21 m	43.42 mn	32.59 l	36.13 p	3.911 gi	4.336 no
T_{11}	5.84 gh	6.16jk	45.09 d	49.92 b	31.96 o	38.63 j	3.835 jk	4.635 ik
T_{12}	6.19 bc	6.51 de	46.41 c	47.26 f	33.87 i	40.12 fg	4.064 f	4.814 df
T_{13}	5.80 gi	5.97 mn	41.95 h	42.82 o	35.34 g	35.20 q	4.241 e	4.224 p
T_{14}	5.56 k	6.21 hij	38.19 n	47.66 e	31.82 o	39.70 h	3.819 kl	4.764 eg
T_{15}	5.14 n	6.60 c	37.62 o	46.23 i	31.27 p	38.48 jk	3.752 lm	4.617 il
T_{16}	5.72 ij	6.35 g	39.92 l	45.41 j	32.90 k	37.85 m	3.947 gi	4.542 l
T_{17}	5.74 hj	6.22 hi	38.93 m	46.94 fg	32.35 mn	39.08 i	3.883 hk	4.689 gi
T_{18}	5.63 jk	5.76 q	44.99 d	42.51 o	36.59 e	36.22 p	4.391 d	4.347 no
T_{19}	5.56 k	6.09 l	42.85 g	45.73 j	34.23 h	39.55 h	4.107 f	4.746fh
T_{20}	6.09 cd	6.16 k	44.04 f	46.34 hi	38.57 b	36.70 o	4.628 b	4.403 mn
T_{21}	6.09 cd	6.24 h	40.70 jk	48.24 d	37.44 c	40.40 ef	4.493 c	4.849 de
T_{22}	5.88 fg	5.88 o	43.75 f	43.76 lm	35.69 f	37.10 n	4.283 e	4.452 m
T_{23}	5.90 fg	6.58 c	40.57 k	44.04 l	37.29 cd	41.84 c	4.474 c	5.021 c
T_{24}	5.53 k	6.00 m	32.60 p	44.54 k	31.15 p	34.20 r	3.738 m	4.104 q
T_{25}	5.83 gh	6.45 f	41.45 i	43.24 n	32.58 l	38.21 kl	3.909 gj	4.585 jl
T_{26}	5.95 ef	5.94 n	39.00 m	45.66 j	32.51 lm	38.02 lm	3.902 hj	4.562 kl
T_{27}	6.12 bd	6.18 ik	40.95 jk	48.20 d	38.45 b	40.70 de	4.614 b	4.884 d
T_{28}	5.60 k	5.80 pq	41.11 ij	42.59 o	32.96 k	36.72 o	3.956 gh	4.407 mn
T_{29}	6.04 de	6.46 ef	46.24 c	48.94 c	34.04 i	40.14 f	4.084 f	4.817 df
T_{30}	6.38 a	6.74 b	39.85 l	47.65 e	37.39 c	43.07 b	4.487 c	5.169 b

T_1: 50 % NPK of the recommended **T_7=T_1+T_2+T_3** **T_{13}= T_1+T_{10}** **T_{19}= T_2+T_{10}** **T_{25}= T_3+T_2+T_8**
T_2 Humic acid **T_8= Royal gel** **T_{14}= T_3+T_8** **T_{20}= T_1+T_3+T_{10}** **T_{26}= T_1+T_2+T_8**
T_3:Magnetic iron **T_9= Salicylic acid** **T_{15}= T_3+T_9** **T_{21}= T_1+T_3+T_9** **T_{27}= T_1+T_2+T_9**
T_4 = T1+T3 **T_{10}= Proline amino acid** **T_{16}= T_3+T_{10}** **T_{22}= T_1+T_3+T_8** **T_{28}= T_1+T_2+T_{10}**
T_5 = T1 +T_2 **T_{11}= T_1+T_8** **T_{17}= T_2+T_8** **T_{23}= T_3+T_2+T_9** **T_{29}= T_2+T_9+T_8**
T_6= T2+T3 **T_{12}= T_1+T_9** **T_{18}= T_2+T_9** **T_{24}= T_3+T_2+T_{10}** **T_{30}= 100 % NPK**

Table 12. Effect of the interaction between sowing dates and some stimulant treatments on yield and its components of pea during the first season (2016/2017).

Characters	Pod number/plant		100-seed weight (g)		Yield/plant (g)		Total yield (t/fed)	
Treatments	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.
T_1	6.72 a	6.03jl	32.69 h	25.95 / j	39.17 g	32.32u	4.700f	3.878qr
T_2	5.38 bd	5.06 /e	40.47 s	34.66 /ef	33.68s	28.84c	4.041op	3.461wx
T_3	6.20 fi	5.02 /e	52.02 b	43.22 kl	36.46k	29.92za	4.375hi	3.590uv
T_4	5.74 rw	5.06 /e	43.18kl	34.45 /ef	35.93l	28.64/c	4.312ij	3.437xy
T_5	6.66 ab	6.12 hj	50.06 c	39.02 v	41.76 b	32.50 u	5.011 b	3.900qr
T_6	6.29 eg	5.96 ko	47.34 f	40.37 st	39.44ef	33.61s	4.733ef	4.034op
T_7	6.55 bc	5.90lq	55.00 a	43.00 lm	45.65 a	35.81l	5.478 a	4.298ik
T_8	4.53 /f	3.87 /g	47.04 f	38.79 v	23.01f	17.92 /g	2.761 a	2.150/b
T_9	5.56 xa	5.07 /e	39.77 tu	35.02 /de	29.80za	24.59 /e	3.576uv	2.951z
T_{10}	5.10 e	4.95 /e	42.49mn	35.93 /ac	35.34 m	29.85za	4.241 jm	3.582uv
T_{11}	6.01 jm	5.68 ux	48.97 d	41.22 qr	34.50 p	29.42 /b	4.140 lo	3.531ux
T_{12}	6.25 ei	6.14 gj	48.02 e	44.80 h	36.00l	31.74 v	4.320ij	3.809 rs
T_{13}	6.13 hj	5.48 zc	45.99 g	37.92 w	39.29fg	31.40 w	4.715f	3.768s
T_{14}	5.86 ms	5.27/d	42.00 np	34.38 /f	34.98no	28.67 c	4.198 kn	3.440xy
T_{15}	5.68 ux	4.60 /f	41.84 oq	33.41 /g	34.76o	27.78 /d	4.171 ln	3.334y
T_{16}	5.94 lp	5.50zc	43.35 jl	36.49 za	35.82l	29.98z	4.298ik	3.597uv
T_{17}	5.82 ou	5.66 vy	40.66 rs	37.20 xy	33.81s	30.90x	4.058op	3.708st
T_{18}	5.84 nt	5.43 ac	47.01 f	42.97 lm	37.84h	35.35m	4.541g	4.242jl
T_{19}	5.77 qv	5.36 /cd	47.98 e	37.73 wx	37.10i	31.36 w	4.452gh	3.763s
T_{20}	6.30 ef	5.88 lr	48.75 d	39.34 uv	40.45cd	36.69jk	4.854cd	4.403 hi
T_{21}	6.38 de	5.80 pv	43.28 kl	38.12 w	39.68e	35.21mn	4.762df	4.225jm
T_{22}	5.89 lr	5.87 mr	46.03 g	41.48 pq	36.93ij	34.46 pq	4.432h	4.135 mo
T_{23}	6.20fi	5.60 wz	43.95 ij	37.19 xy	40.36 d	34.22 qr	4.843cd	4.106no
T_{24}	5.60 wz	5.47 zc	35.74 bc	29.47 /i	33.10 t	29.21b	3.972pq	3.505vx
T_{25}	5.96 ko	5.71 sx	44.87 h	38.04 w	34.15r	31.01x	4.098 no	3.721st
T_{26}	6.25 ei	5.66 vy	42.41 mo	35.60/cd	35.31m	29.72 /a	4.238jm	3.566uw
T_{27}	6.26 eh	5.99 jn	45.55 g	36.36 zb	40.25d	36.66k	4.830 ce	4.399hi
T_{28}	5.69 tx	5.52 yb	45.49 g	36.73yz	35.96 l	29.97 z	4.315ij	3.597 uv
T_{29}	6.49 cd	5.60 wz	48.37 de	44.11i	37.84 h	30.24y	4.540g	3.629tu
T_{30}	6.66ab	6.10 jk	43.73 ik	35.98/ac	40.63 c	34.16r	4.875 c	4.099no

T_1: 50 % NPK of the recommended **T_7=T_1+T_2+T_3** **T_{13}= T_1+T_{10}** **T_{19}= T_2+T_{10}** **T_{25}= T_3+T_2+T_8**
T_2 Humic acid **T_8= Royal gel** **T_{14}= T_3+T_8** **T_{20}= T_1+T_3+T_{10}** **T_{26}= T_1+T_2+T_8**
T_3:Magnetic iron **T_9= Salicylic acid** **T_{15}= T_3+T_9** **T_{21}= T_1+T_3+T_9** **T_{27}= T_1+T_2+T_9**
T_4 = T1+T3 **T_{10}= Proline amino acid** **T_{16}= T_3+T_{10}** **T_{22}= T_1+T_3+T_8** **T_{28}= T_1+T_2+T_{10}**
T_5 = T1 +T_2 **T_{11}= T_1+T_8** **T_{17}= T_2+T_8** **T_{23}= T_3+T_2+T_9** **T_{29}= T_2+T_9+T_8**
T_6= T2+T3 **T_{12}= T_1+T_9** **T_{18}= T_2+T_9** **T_{24}= T_3+T_2+T_{10}** **T_{30}= 100 % NPK**

Table 13. Effect of the interaction between sowing dates and some stimulant treatments on yield and its components of pea during the second season (2017/2018).

Characters	Pod number/plant		100-seed weight (g)		Yield/plant (g)		Total yield (t/fed)	
Treatments	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.	1st week of Sept.	1st week of Feb.
T_1	7.09 a	6.55 gh	27.56/b	21.52 /c	39.65l	37.73 o	4.799lmn	4.527rt
T_2	6.02su	5.75 w	46.86jk	42.40t	39.01 m	35.25st	4.681np	4.230wz
T_3	6.85 cd	6.34mo	53.59 b	44.33 pq	42.33 g	37.09p	5.080fh	4.451tu
T_4	5.94 v	5.59xy	45.34n	39.85 x	37.72 o	33.20 v	4.559qt	3.985cd
T_5	6.90 bc	6.31o	52.02cd	46.03 lm	43.26ef	38.36 n	5.192ef	4.604ps
T_6	6.77 e	6.14 pr	50.52e	44.94no	42.04 g	37.52 op	5.045 gh	4.502st
T_7	6.95 b	6.16pr	59.45 a	46.57k	49.41 a	38.75 mn	5.930 a	4.650oq
T_8	4.88 /a	4.56/b	48.03i	45.31 n	27.28x	21.57y	3.274g	2.588h
T_9	6.09rt	5.55yz	43.53r	38.76 yz	40.19jk	33.97u	4.823km	4.076 /bc
T_{10}	6.84 ce	6.10qs	48.64g	38.20 /a	40.49 ijk	31.78w	4.859km	3.814/f
T_{11}	6.37lo	5.96uv	53.45 b	46.39km	40.96hi	36.30 q	4.915 jl	4.356uv
T_{12}	6.62fg	6.40 km	52.19 c	42.34t	41.97g	38.27n	5.036hi	4.593ps
T_{13}	6.30 o	5.64x	47.20j	38.44 za	38.43 n	31.98w	4.612ps	3.837/ef
T_{14}	6.64 f	5.79 w	53.38 b	41.95tv	44.49cd	34.91t	5.339 cd	4.190yb
T_{15}	6.82 de	6.39 kn	50.35e	42.12tu	41.94g	35.02t	5.033 hj	4.202ya
T_{16}	6.68 f	6.02tv	48.70 g	42.12tu	40.55 hk	35.16t	4.866km	4.219xz
T_{17}	6.46 ik	5.98uv	49.36 f	44.53oq	41.02 h	37.14p	4.923ik	4.456tu
T_{18}	6.04 su	5.48z	45.97m	39.06y	39.62 l	32.83 v	4.755mo	3.939/de
T_{19}	6.22p	5.96 uv	48.09 hi	43.38rs	43.04f	36.06qr	5.165eg	4.327vx
T_{20}	6.50 hj	5.82 w	48.55 gh	44.13 q	40.63hj	32.77 v	4.875km	3.932/df
T_{21}	6.44 jl	6.04su	50.45 e	46.03lm	43.66 e	37.15p	5.240de	4.458tu
T_{22}	6.17 pq	5.59xy	46.54 kl	40.98w	40.11kl	34.10u	4.813km	4.092/ac
T_{23}	6.84 ce	6.32no	46.37km	41.72 uv	44.94 c	38.74mn	5.393 c	4.649oq
T_{24}	6.36mo	5.64x	48.30gi	40.78 w	36.25qr	32.15w	4.350uw	3.858/ef
T_{25}	6.53 hi	6.38 ko	44.91no	41.57v	41.01h	35.41st	4.921ik	4.249vy
T_{26}	6.13qr	5.75w	48.35 gi	42.98 s	40.34jk	35.71rs	4.840km	4.285vy
T_{27}	6.56 gh	5.80 w	51.66 d	44.75op	44.28 d	37.12 p	5.314 cd	4.454tu
T_{28}	5.98 uv	5.63x	44.57oq	40.61 w	39.05 m	34.40 u	4.686np	4.128 zb
T_{29}	6.53 hi	6.39kn	53.18 b	44.70op	43.03f	37.25op	5.164eg	4.470tu
T_{30}	7.09a	6.40 km	50.80e	44.51oq	47.43 b	38.72mn	5.692 b	4.646 or

T_1: 50 % NPK of the recommended
T_2 Humic acid
T_3:Magnetic iron
T_4 = T1+T3
T_5 = T1 +T_2
T_6= T2+T3
T_7=T_1+T_2+T_3
T_8= Royal gel
T_9= Salicylic acid
T_{10}= Proline amino acid
T_{11}= T_1+T_8
T_{12}= T_1+T_9
T_{13}= T_1+T_{10}
T_{14}= T_3+T_8
T_{15}= T_3+T_9
T_{16}= T_3+T_{10}
T_{17}= T_2+T_8
T_{18}= T_2+T_9
T_{19}= T_2+T_{10}
T_{20}= T_1+T_3+T_{10}
T_{21}= T_1+T_3+T_9
T_{22}= T_1+T_3+T_8
T_{23}= T_3+T_2+T_9
T_{24}= T_3+T_2+T_{10}
T_{25}= T_3+T_2+T_8
T_{26}= T_1+T_2+T_8
T_{27}= T_1+T_2+T_9
T_{28}= T_1+T_2+T_{10}
T_{29}= T_2+T_9+T_8
T_{30}= 100 % NPK

CONCLUSION

From the obtained results of this research, it could be recommended that sowing pea on the 1st week of Sept and fertilizing plants with NPK at 50 % RR + humic acid at 10 kg /fed.+ magnetic iron at 100 kg/fed. was the best treatment for enhancing plant growth of pea and recorded the highest productivity of green pods in clay soil under the same conditions.

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تاثير بعض المستحثات علي انتاجية البسلة تحت ظروف الإجهاد الحراري

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تم إجراء تجربة حقلية بالمزرعة البحثية بالبرامون ، محافظة الدقهلية ، مصر ، خلال موسمى 2017/2016 و2018/2017 لدراسة تأثير مواعيد الزراعة وبعض منشطات النمو على النمو والمحصول ومكوناته وجودة البذور في القرون الخضراء للبسلة صنف Master B. تم تنفيذ التجربة في تصميم القطع المنشقة مرة واحدة فى ثلاثة مكررات. تم تخصيص القطع الرئيسية لمواعيد الزراعة. فى حين تم تخصيص القطع الشقية لثلاثين معاملة لمنشطات النمو. سجلت زراعة البسلة في الأسبوع الأول من شهر سبتمبر أفضل النتائج لزيادة طول النبات وعدد الأوراق والأوزان الطازجة والجافة. ونتجت أعلى القيم لمحتويات N و P و K في الأوراق وعدد القرون / النبات والمحصول لكل من النبات الفدان من الزراعة في الأسبوع الأول من شهر فبراير في كلا الموسمين. بينما زاد محتوى البرولين ونشاط إنزيم أوكسيديز مع زراعة البسلة في فبراير مقارنة بالزراعة في سبتمبر . أنتجت نباتات البسلة المعالجة بـ NPK بنسبة 50٪ من المعدل الموصى به + حمض الهيومك + حديد مغناطيسي أعلى القيم لطول النبات ، عدد الأوراق ، إجمالي الوزن الطازج / النبات وإجمالي الوزن الجاف / النبات ، محصول النبات والمحصول الكلى/ فدان في كلا الموسمين ووزن 100 بذرة في الموسم الثاني. في حين أن الرش نباتات البسلة بالحمض الأميني برولين أدى إلى زيادة محتوى البرولين ونشاط إنزيم أوكسيديز في الأوراق في الموسم الثاني. تم الحصول على أعلى محتوى للنيتروجين والفوسفور والبوتاسيوم بالأوراق من معاملة NPK بنسبة 50٪ + حمض الهيوميك + برولين في كلا الموسمين. أدى التفاعل بين زراعة البسلة في الأسبوع الأول من شهر سبتمبر والتسميد بنسبة 50 ٪ من المعدل الموصى به من NPK + حمض الهيوميك + حديد مغناطيسي لزيادة ارتفاع النبات وعدد الأوراق ، إجمالي الوزن الطازج / النبات وإجمالي الوزن الجاف / النبات ، محصول النبات والمحصول الكلى / فدان في كلا الموسمين ووزن 100 بذرة في الموسم الثاني. في حين أدى التفاعل بين الزراعة في الأسبوع الأول من شهر فبراير والرش بالحمض الأمينى البرولين بمعدل 25 جزء في المليون لزيادة محتوى البرولين ونشاط إنزيم أوكسيديز في الأوراق مقارنة بمعاملات التفاعل الأخرى في الموسم الثاني. وفي الوقت نفسه ، أعطت معاملة T28 تحت الزراعة المبكرة (الأسبوع الأول من سبتمبر) أعلى القيم لصفات N وK وأدنى القيم لمحتوى البرولين وإنزيم أوكسيديز.