Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www.jpp.journals.ekb.eg

Some Agronomical Practices for Improving Growth ,Yield and Quality of Pea Growing at Late Seasons.

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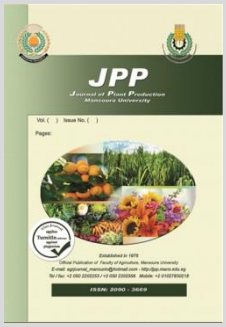

ABSTRACT

This work was carried out at the Experimental Farm of El-Baramoon Research Station, Horticulture Research Institute, Agricultural Research Center, during the late winter season of 2018 and 2019 to study the effect of two sowing dates (20th January and 20th February), foliar applications, i.e., brassinolide (5 and10 mg/l), mixture of growth regulator (0.5 and 1cm/l), dry yeast extract (5 and 10gm/l) potassium nitrate (1 and 2 gm/l) and potassium silicate (2.5 and 5gm/l) in addition to vernalization practice and their interactions on growth, yield and its components characteristics of pea cv. Master- B.The obtained results revealed that, the first sowing date induced a higher growth values , yield and its components and chemical composition of seeds compared with the second sowing date. Spraying brassinolide at 10 mg/l gave the highest growth, yield and chemical components of pea plants, followed by potassium nitrate at 2gm/l, growth regulators mixture at 1cm/l and yeast extract at 10gm/l. Sowing pea seeds in 20th January and spraying with brassinolide at 10 mg/l introduced the best interaction with respect to growth, yield components and chemical composition of seeds. From the obtained results it could be recommended that sowing pea in 20th January and spraying with brassinolide (10 mg/l) and/or potassium nitrate at 2gm/l, and/or growth regulators mixture at 1cm/l and/or yeast extract at 10 gm/l improved growth, yield and chemical composition of pea growing at late season conditions .

Keywords: pea, sowing date, brassinolide, yeast, potassium, silicate, vernalization

INTRODUCTION

Pea (*Pisum sativum* L.) is one of the important vegetable crops belonging to the family Fabaceae (leguminosae) grown during winter season in Egypt for local consumption and exportation. It is highly nutritive vegetable containing high percentage of protein (21-25 %), carbohydrates, vitamin A and C, Ca, phosphorous and has elevation levels of amino acids lysine and tryptophan (Bhat *et al*., 2013). In addition, its agriculture preserve soil fertility through biological nitrogen fixation in organization with symbiotic rhizobium prevailing in its root nodules.

Sowing date significantly influenced the growth and yield attributes of vegetable crops and the sowing at proper time allows sufficient growth and development of a crop to obtain a satisfactory yield for growers. The different environmental conditions, especially temperature due to different sowing time provide variable in crop growth, development and yield stability (Pandey *et al*., 1981). Garden pea is a cool loving crop grows well in winter and partly moist climatic condition and the best mean temperature was 13-18 ° C. The increase in temperature above 20 °C in late sowing date decreases the yield and quality of immature seeds.

Alongside, some agricultural practices such as vernalization are used for improving the yield and quality of vegetable crops, especially at late sowing conditions. Vernalization is the process whereby the plant acceleration the ability of blossoming by cold treatment. In this process the seeds are exposure to the low temperature by soaking in cold water for forcing the growing plant from the vernalization seed to early yield (Mohammad and Al-Yuonis, 1991). Vernalization of the seeds produces GA_3 up to six time what the plant produces under the normal growing condition and later that GA_3 helps in the early flowering of vernalized plants (Fernandes *et al*., 1997 and Al-Ubaydi, 1999).

Likewise, potassium (K) is one of the vital elements among the plant nutrients found to be overcome abiotic stress through the regulatory function in many biochemical processes related to enzyme activation, carbohydrate metabolism, and protein synthesis. Various sources of K salts such as potassium nitrate (KNO_3) and potassium silicate ($K_2O.{}_4SiO_2$) can be used for plants nutrition giving a good results in growth and yield of plants under abiotic stress (Jabeen and Ahmad, 2011). Spraying potassium silicate or potassium nitrate led to stimulate growth, increasing yield components, enhancing the most of growth parameters and giving the highest values of minerals concentration (Salim *et al*., 2014).

Nowadays plant growth regulators have been used to increase the growth and yield of pea under stress conditions. Pea plant was found to show a quick growth, higher yield and quality when treated with plant growth regulators especially GA_3 and NAA (Kumar *et al*., 2014). Gibberellic acid is known to be importantly concerned in the regulation of plant responses to the external environment (Chakrabarti and Mukherji, 2002). Naphthalene acetic acid (NAA) is another plant growth regulator and an important synthetic auxin has a wide variety of impacts on plants. Different effects of the application of NAA in the acceleration of rooting, control

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DOI: 10.21608/jpp.2020.112890

of flowering, prevention of fruit drop and increase of fruit formation have been observed in different plants (Prakash and Ganesan, 2001).

Brassinolide (BR), a novel plant growth promoting steroidal lactone has a role in cell division, expansion and differentiation, source-sink relations and other endogenous interactions (Sasse, 2003). Exogenous application of BR can improve the stress tolerance in plants by improving the plant growth, synthesis of photosynthetic pigments and antioxidant enzymes activity (Niu *et al.,* 2016).

Many studies reported that yeast is considered as one of the natural richest and safest sources of essential amino acids, essential elements, B-complex vitamins, furthermore, bio-constituents, especially, cytokinins. In this regard, Mahmoud *et al.* (2013), Ibraheim (2014) and Zaghloul *et al.* (2015) on pea all of them mentioned the beneficial effect of yeast extract foliar application for improving vegetative growth parameters, flowering, total yield and pods quality.

Therefore, the main goal of the present work was to study the response of pea plants to sowing dates as a principle factor along with exogenous foliar applications, i.e., potassium nitrate, potassium silicate, mixture of growth regulators (gibberellin and naphthalene acetic acid), brassinolide and yeast extract in addition to vernalization practice to identify the best treatments for achieve the highest return for the growers under the experimental conditions.

MATERIALS AND METHODS

Two field experiments were carried out during late winter seasons of 2018 and 2019, at the experimental farm of El-Baramoon Research Station, El-Mansoura, Horticulture Research Institute, Agricultural Research Center, Egypt to study the effect of two late planting dates , some foliar applications, in addition to vernalization practice and interaction between them on vegetative growth, yield and component of Pea (*Pisum sativum* L.) cv. Master- B. Local maximum and minimum temperature and relative humidity during the two growing seasons of study are presented in Table (1).

Table 1. Maximum and minimum temperature (C) and relative humidity % during the two growing seasons.

Month	January	February	March	April	May	June
2018 season						
Max. temp.	18.9	20.4	23.5	28.3	32	33.9
Min. temp.	9.7	11.6	14.6	17.7	20.1	22
R. H. (%)	59	54	53	47	46	49
2019 season						
Max. temp.	19.9	21.2	24.3	28.9	33.1	33.9
Min. temp.	10.1	12.3	15.2	18.3	21.6	22.5
R. H. (%)	70	55	56	50	53	55

Egyptian Meteorological Authority

The experimental design and treatments:

The used design was a split-plot with three replications. Each of the two planting dates was randomized ranked within each replications as a main plot and foliar applications treatments in addition to vernalization practice were randomized within each data as sub-plot. The experimental plot contained 4 ridges (2 pod yield and 2 dry seeds yield) of 4 meters long and 1 meter width thus making an area of 16 m^2.

Dry treated seeds with appropriate fungicides were planted when the soil humidity was suitably in hills (2seeds/hill) with 15 cm distance, Each sup plot was planted by 240 gm seeds (60 Kg/feddan) . The seeds were obtained from the Egypt ion Agriculture Society.

This experiment included 24 treatments were arranged as follow:

A- Sowing date:

1- Sowing in 20th January.
2- Sowing in 20th February.

B- Foliar applications and vernalization practice:

1- Brassinolide ($C_{28}H_{48}O_6$) at the rate of 5 mg/L.
2- Brassinolide ($C_{28}H_{48}O_6$) at the rate of 10 mg/L.
3- Mixture of plant growth regulator at 0.5 cm/L.
4- Mixture of plant growth at 1 cm/L.
5- Dry yeast extract at 5 gm/L.
6- Dry yeast extract at 10 gm/L.
7- Potassium nitrate (KNO_3) at 1gm/L.
8- Potassium nitrate(KNO_3) at 2 gm/L.
9- Potassium silicate (K_2SIO_3) at 2.5 gm/L.
10- Potassium silicate (K_2SIO_3) at 5 gm/L.
11- Vernaliztion practice
12- Control (sprayed by tap water).

The plants were sprayed with foliar applications two times, the first at 45 days from sowing and the second after two weeks from the first. The recommended cultural practices i.e., irrigation, pest and diseases control, etc. of pea plant were applied for commercial production in the area.

Brassinolide compound were obtained from Techno gene Company, Dokki, Giza, Egypt. Yeast extract was prepared according to the method described by El-Ghamriny *et al*. (1999). Potassium nitrate and potassium silicate obtained from El-Gomhoria Chemical Company. Vernalization treatment was applied by soaking pea seeds in distilled water for 30 minutes, then removed and dried in room temperature, then put in the refrigerator at 4 ±1 and relative humidity 85-90 % for 14 days.

Recorded data:

1-Vegetative characteristics:

At 60 days after sowing, five plants were randomly marked from each sup plot for determining the mean stem length (cm), leaf area (cm2), plant fresh weight (g) and plant dry weight (g).

Fresh leaves were randomly collected from each plant and ten disks of these fresh leaves were made by known diameter Cork borer, then oven dried at 70 C0 till reaching constant weight and the leaf area was calculated according to Koller (1972) as follows:

$$\text{Total leaf area } (cm^2) = \frac{\text{Area of the disks } (cm^2) \times \text{Dry weight of leaves/plant}}{\text{Dry weight of disks}}$$

2- Yield and its components characteristics:

Green pods of each sup plot were harvested at the proper maturing stage, counted and weight in each harvest

and the shelling percentage (%), pod yield /plant (gm), total pod yield (ton /fed) and total dry seed yield (ton /fed) were calculated.

Shelling percentage (%)

$$\text{Shelling (\%)} = \frac{\text{Weight of green seeds}}{\text{Total weight of green pods}} \times 100$$

3- Seed quality

Reducing sugars were determined in green seeds extract according to Miller (1959). Meanwhile, total soluble sugars were measured spectrophotometrically according to Dubois *et al*. (1956). Non reducing sugars were calculated as the differences between total soluble sugars and reducing sugars Carbohydrates (%)was determined calorimetrically in dry matter of pods following the method described by Dubois *et al*. (1956). Crude protein content was determined as total nitrogen multiplied by 6.25 to calculated total crude protein

All data were statistical analysis accordance to the procedure out lined by Snedecore and Cochran (1968) and the treatment means were compared using (LSD). Data were statistically analyzed using Co-STAT computer software program.

RESULTS AND DISCUSSION

1-Vegetative growth characters:

A-Effect of sowing dates:

Data presented in Table (2) illustrate the effect of sowing dates on some vegetative growth parameters represented by mean stem length (cm), leaf area (cm^2), plant fresh weight (g) and plant dry weight (g) in both seasons of the study. According to mean stem length, a significant difference obtained between 20th January and 20th of February planting in both seasons. The average mean stem length was taller with values of (42.97 and 46.16 cm) in January planting than those obtained in February one (37.94 and 40.83 cm) in 2018 and 2019 seasons respectively. As for leaf area, the data in the same Table show that, January planting produced plants having leaf area longer than that produced by plants grown in February planting. The same trend was obtained in both seasons of study with highly significant.

Obviously, the rest vegetative growth traits (plant fresh weight and plant dry weight) as shown in Table (2) were positively affected by planting dates. The results clearly indicated that, January planting had a slight increase in plant fresh and dry weight than February planting in the and second years The difference was significant in both seasons

Table 2. Effect of planting dates on vegetative growth of pea plants at 60 days after sowing during 2018 and 2019 late winter seasons.

Characters	Mean stem length (cm)		Leaf area (cm^2)		Fresh weigh (gm)		Dry weight (gm)	
Treatments	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**
20th January	42.97	46.16	407.80	435.33	67.82	71.79	17.91	18.03
20th February	37.94	40.83	333.33	340.79	61.84	65.90	14.40	13.96
LSD at 0.05 %	0.520	1.434	19.669	21.610	0.134	1.339	0.893	0.449

B-Effect of foliar applications and vernalization practice:

Data presented in Table (3) reveal the effect of foliar application of tested substances and vernalization practice on studied vegetative growth parameters during 2018 and 2019 seasons. As clear from the data, the mean stem length was significantly affected by all treatments in both years when compared to control. Brassinolide spraying at the rate of 10 mg/l resulted in the production of the highest mean stem length followed by potassium nitrate at 2gm/l, brassinolide at 5 mg/l, potassium nitrate at 1gm/l and the yeast extract at the both rates 5and 10gm/l.

The same Table show that, foliar application of brassinolide at 10 mg/l gave the highest leaf area followed by potassium nitrate at (2gm/l or1gm/l), brassinolide at 5 mg/l and yeast extract at 10gm/l in both years. According to plant fresh weight, the obtained results in the same table exhibited surpass of 10 mg/l brassinolide treatment followed by potassium nitrate at (2g/l or 1gm/l), brassinolide at 5 mg/l and yeast extract at 10gm/l. Likewise, the plant dry weight as affected by tested foliar application treatments and vernalization practice, take the same behavior of plant fresh weight in both seasons. The results demonstrate clearly that, highest record of plant dry weight was obtained from the foliar by brassinolide at 10 mg/l followed by potassium nitrate at 2g/l , brassinolide at 5 mg/l and yeast extract at the rate 10gm/l.

Table 3. Effect of some foliar applications and vernalization practice on vegetative growth of pea plants at 60 days after sowing during 2018 and 2019 late winter seasons.

Characters	Mean stem length (cm)		Leaf area (cm^2)		Fresh weight (gm)		Dry weight (gm)	
Treatments	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**
Br 5 mg/l	41.83	45.00	398.99	413.86	70.73	73.11	18.16	18.90
Br 10 mg/l	45.33	48.5	437.39	456.46	75.03	76.66	20.03	20.98
Mix 0.5 cm/l	38.83	41.00	367.55	376.26	64.53	66.81	13.11	13.41
Mix 1 cm/l	40.00	42.33	370.12	383.30	66.18	67.80	14.33	14.51
Yeast 5 g/l	41.00	44.16	378.92	405.06	63.80	65.13	16.13	16.78
Yeast 10 g/l	41.00	44.16	380.18	408.36	67.50	70.65	16.88	17.68
KNO_3 1 g/l	41.66	44.82	398.04	420.23	70.86	72.78	17.25	17.65
KNO_3 2 g/l	43.33	46.66	407.85	432.43	68.86	75.25	18.50	19.80
K_2SIO_3 2.5 g/l	38.00	41.16	346.82	349.70	60.16	65.06	14.05	14.05
K_2SIO_3 5 g/l	38.66	42.16	348.66	352.46	60.20	65.11	13.36	13.73
Vernalization	40.16	43.16	322.77	351.75	60.90	68.86	15.95	15.76
Control	35.66	38.33	289.50	306.83	49.20	58.95	10.73	10.93
LSD at 0.05 %	1.008	1.831	15.407	13.949	1.194	2.166	1.051	0.918

Br: brassinolide and Mix: (gibberellic acid at 2.5 %, 4 - chlorophenoxy acetic acid at 2.5 % and naphthalene acetic acid at 2.5 %).

C-Effect of the interaction :

The effect of interaction on vegetative growth parameters (mean stem length ,leaf area , plant fresh weight and plant dry weight) presented in Table (4). The obtained results show that, control plants of February planting had the lowest plant length in both years . While the interaction between January planting and r by brassinolide foliar at 10 mg/l exhibited the highest mean stem length followed by January planting with potassium nitrate spraying at 2g/l in both seasons. With respect to leaf area, the results in the previous Table demonstrate clearly that, the highest record values obtained from the interaction between January planting and Foliar by brassinolide at the rate of 10 mg/l in both years followed by the interaction between January planting and sparing with potassium nitrate at 2g/l in both seasons. While, control plants of February planting had the lowest value in both years.

Table 4. Effect of the interaction between sowing dates and foliar application and vernalization treatments on plant length, leaf area, fresh weight and dry weight of pea plants at 60 days after sowing during 2018 and 2019 late winter seasons.

Characters		Mean stem length (cm		Leaf area (cm^2)		Fresh weight (gm)		Dry weight (gm)	
Treatments		2018	2019	2018	2019	2018	2019	2018	2019
A x B									
20 th January	Br 5 mg/l	44.33	47.66	443.02	471.18	73.90	76.16	19.86	20.86
	Br 10 mg/l	48.33	51.00	474.75	505.38	78.20	79.83	22.26	21.80
	Mix 0.5 cm/l	41.33	45.00	406.86	419.62	67.50	69.80	16.96	16.80
	Mix 1 cm/l	42.33	45.00	407.45	419.29	69.20	70.80	15.30	15.26
	Yeast 5 g/l	43.33	46.66	413.08	465.86	66.76	68.13	19.13	19.70
	Yeast 10 g/l	43.33	46.66	419.70	470.41	70.50	74.20	19.56	19.90
	KNO_3 1 g/l	44.33	47.33	441.07	471.53	71.86	75.86	19.60	20.50
	KNO_3 2 g/l	46.33	49.33	446.57	485.96	73.80	78.76	20.26	21.13
	K_2SIO_3 2.5 g/l	40.33	43.66	364.43	366.54	63.13	68.63	16.53	15.80
	K_2SIO_3 5 g/l	40.66	44.66	365.38	370.94	63.23	67.46	14.56	14.53
	Vernalization	42.66	45.66	365.52	417.19	63.56	71.83	18.30	18.03
	Control	38.33	41.33	325.83	359.03	52.20	60.06	12.56	12.20
20 th February	Br 5 mg/l	39.33	42.33	354.96	355.54	67.56	76.16	16.46	16.93
	Br 10 mg/l	42.33	46.00	400.02	407.54	71.86	79.83	17.80	18.36
	Mix 0.5 cm/l	36.33	37.00	328.24	346.98	61.56	69.80	11.70	12.20
	Mix 1 cm/l	37.66	39.66	332.79	333.24	63.16	70.80	10.93	11.56
	Yeast 5 g/l	38.66	41.66	324.77	344.25	60.83	68.13	13.13	13.86
	Yeast 10 g/l	38.66	41.66	340.67	346.31	64.50	74.20	14.20	15.46
	KNO_3 1 g/l	39.00	42.33	355.01	368.94	65.86	75.86	14.90	14.80
	KNO_3 2 g/l	40.33	44.00	369.13	378.91	68.93	78.70	15.53	15.96
	K_2SIO_3 2.5 g/l	35.66	38.66	329.22	332.86	57.20	68.63	11.56	12.93
	K_2SIO_3 5 g/l	36.66	39.66	331.95	333.98	57.16	67.46	12.16	12.20
	Vernalization	37.66	40.66	280.02	286.31	58.23	65.90	13.60	13.5
	Control	33.00	36.00	253.16	254.63	46.2	57.83	8.90	9.66
LSD at 0.05 %		1.415	2.589	21.788	19.728	1.689	3.063	1.486	1.298

Br: brassinolide and Mix: (gibberellic acid at 2.5 %,4 - chlorophenoxy acetic acid at 2.5 % and naphthalene acetic acid at 2.5 %).

Obvious from the data presented in Table (4) it revealed that, significant differences were obtained in both years. The interaction between January planting date and foliar application by brassinolide at the rate of (5 or 10 mg/l) had the highest record of the plant fresh weight followed by the interaction between January planting and foliar of potassium nitrate at the rate of (1 or 2gm/l) and yeast extract at the rate 10gm/l in both years. Likewise, the dry weight of plants all interaction between planting dates and foliar application and vernalization treatments take the same trend was obtained from plant fresh weight in both season.

The obtained results about planting dates are in agreement with Ali *et al.* (2016) who indicated that the variation in growth duration of pea might be due to variation in day/night temperature and increased in temperature at the later sowing curtailed the crop growth duration. Similar results were recorded by Ezeaku*et al.* (2015), Sirwaiya and Kushwah (2018) and Sumalatha and Uppar (2019).

Concerning the effect of foliar treatments (brassinolide, growth regulators, yeast, KNO_3 and K_2SIO_3) and vernalization practice on vegetative growth, our results similar that obtained by Afifi *et al.* (2018) and El-Sayed *et al.* (2019a) on brassinolide, Rahman *et al.* (2015) and Kumar *et al.* (2018) on growth regulators, Elrys and Merwad (2017) and Ismail *et al.* (2017) on potassium silicate, Marhoon *et al.* (2018) and El-Sayed *et al.* (2019b) on yeast, Jadhav *et al.* (2019) and Bangar *et al.* (2019) on potassium nitrate and Abbas *et al.* (2010) and Al-Ubaid and Mohammed (2018) on vernalization.

2-Yield and its components characteristics:

A-Effect of sowing dates:

Data presented in Table (5) show that, significant difference was obtained between 20th January planting and 20th February planting with respect to pod yield/plant (gm), total pod yield (ton/fed),total dry yield (ton/fed) and shelling percentage in both years. The highest values of total yield per feddan (2.920 and 3.148 ton) were recorded at January planting compared with (2.076 and 2.248) February planting in both studied seasons, respectively.

Table 5. Effect of planting dates on pod yield / plant ,total pod yield, total. dry yield/fed and shelling (%) of pea plants during 2018 and 2019 late winter seasons

Characters	Pod yield/plant (gm)		Total pod yield (ton/fed)		T. dry seed yield/fed (ton/fed)		Shelling (%)	
Treatments	2018	2019	2018	2019	2018	2019	2018	2019
20 th January	50.93	63.12	2.920	3.148	0.584	0.629	44.86	47.77
20 th February	33.06	37.71	2.076	2.248	0.414	0.446	37.30	41.83
LSD at 0.05 %	1.532	1.618	0.028	0.056	0.003	0.008	1.177	0.597

B-Effect of foliar applacation and vernalization practice:

As clear from the data in Table (6) that, pod yield / plant, total pod yield ,total dry seeds yield and shelling percentages were significantly affected by the foliar substances and vernalization practice in all treatments in both years when compared to control .The sparying with brassinolide at 10 mg/l resulted in the production of the highest values of previous yield component parameters followed by potassium nitrate at 2gm/l, mix at 1cm/l and yeast extract at 10gm/l.

C-Effect the interaction :

The effect of interaction between planting dates and foliar applications plus vernalization on pod yield / plant total pod yield , total dry seeds yield and shelling percentages were presented in Table (7).The obtained result prove that, sowing on 20th January and spraying with brassinolide at 10 mg/l followed by potassium nitrate at 2gm/l, yeast extract at 10 g/l and mixture 1cm/l gave the highest values of the shelling percentages, pod yield / plant total pod yield total dry seeds yield and shelling percentages in both seasons.

Moreover, all interactions significantly increased the studied yield and its component parameters compared with control. General speak , sowing pea seeds on 20th January resulted in better yield and its components this maybe refer to earlier sowing provided more period for growth and development which consequently resulted in more number of pod per plant (Sirwaiya and Kushwah, 2018).

Table 6. Effect of some foliar application and vernalization treatments on pod yield / plant ,total pod yield, total dry seed yield/fed and shelling of pea plants during 2018 and 2019 late winter seasons.

Characters	Pod yield/plant (gm)		Total pod yield (Ton/fed)		T. dry yield/fed (ton/fed)		Shelling (%)	
Treatments	2018	2019	2018	2019	2018	2019	2018	2019
Br 5 mg/l	46.84	56.39	2.602	2.912	0.520	0.576	43.33	47.66
Br 10 mg/l	57.58	67.36	2.838	3.145	0.568	0.629	51.33	53.5
Mix 0.5 cm/L	39.98	46.27	2.454	2.608	0.490	0.521	39.16	42.83
Mix 1cm/L	44.59	54.76	2.658	2.915	0.531	0.582	43.33	45.83
Yeast 5 g/L	38.74	45.43	2.400	2.600	0.480	0.516	39.16	42.33
Yeast 10 g/L	44.34	54.96	2.567	2.821	0.513	0.564	43.33	45.83
KNO_3 1 g/L	41.36	43.84	2.475	2.583	0.490	0.516	39.16	45.16
KNO_3 2 g/L	49.25	59.42	2.717	2.934	0.543	0.586	45.00	50.66
K_2SIO_3 2.5 g/L	35.01	46.82	2.366	2.523	0.470	0.499	37.50	44.00
K_2SIO_3 5 g/L	38.08	46.82	2.433	2.554	0.486	0.510	41.33	41.00
Vernalization	36.75	43.35	2.282	2.483	0.456	0.496	38.5	41.33
Control	31.44	37.20	2.185	2.296	0.437	0.457	31.16	34.33
LSD at 0.05 %	1.636	1.951	0.059	0.066	0.016	0.011	1.838	2.057

Br: brassinolide andMix: (gibberellic acid 2.5 %, chlorophenoxy acetic acid 2.5 % and naphthalene acetic acid 2.5 %).

Table 7. Effect of the interaction between sowing dates and foliar application and vernalization treatments on pod yield / plant ,total pod yield,, dry seeds yield/fed and shelling of pea plants during 2018 and 2019 late winter seasons.

Characters		Pod yield/plant (gm)		Total pod yield (Ton/fed)		T. dry yield/fed (ton/fed)		Shelling (%)	
	Treatments	2018	2019	2018	2019	2018	2019	2018	2019
20 th January	Br 5 mg/L	56.68	69.84	3.012	3.433	0.602	0.640	47.66	49.66
	Br 10 mgL	71.42	85.21	3.266	3.558	0.653	0.711	54.33	57.66
	Mix 0.5 cm/L	50.69	60.11	2.866	3.033	0.573	0.606	41.66	45.00
	Mix 1 cm/L	53.71	69.74	3.150	3.454	0.630	0.690	47.66	49.66
	Yeast 5 g/L	46.72	57.24	2.733	2.950	0.546	0.590	42.66	45.33
	Yeast 10 g/L	50.89	64.48	2.958	3.225	0.591	0.645	48.66	49.33
	KNO_3 1 g/L	50.09	60.71	2.891	3.083	0.578	0.616	41.66	49.00
	KNO_3 2 g/L	59.22	74.10	3.208	3.458	0.641	0.691	51.33	53.33
	K_2SIO_3 2.5 g/L	43.15	55.75	2.766	2.962	0.553	0.592	41.00	42.33
	K_2SIO_3 5 g/L	46.82	60.31	2.850	2.983	0.570	0.596	48.00	48.66
	Vernalization	42.85	51.68	2.725	2.908	0.545	0.581	40.33	43.66
	Control	39.48	48.31	2.611	2.725	0.522	0.545	33.33	38.66
20 th February	Br 5 ppm	37.00	42.95	2.161	2.331	0.438	0.466	39.00	44.66
	Br 10 ppm	43.74	49.50	2.308	2.533	0.481	0.546	48.66	49.33
	Mix 0.5 ppm	29.26	32.32	2.041	2.183	0.408	0.436	36.66	40.66
	Mix 1 ppm	36.01	39.78	2.166	2.375	0.433	0.473	39.00	42.00
	Yeast 5 g/L	30.75	33.63	2.066	2.250	0.413	0.443	37.00	39.66
	Yeast 10 g/L	37.79	45.43	2.175	2.416	0.435	0.483	38.00	42.33
	KNO_3 1 g/L	32.63	37.69	2.058	2.195	0.403	0.416	36.66	41.33
	KNO_3 2 g/L	39.28	44.74	2.225	2.408	0.445	0.482	38.66	48.00
	K_2SIO_3 2.5 g/L	29.26	31.94	1.966	2.125	0.387	0.406	34.00	39.33
	K_2SIO_3 5 g/L	26.88	33.32	2.016	2.150	0.403	0.425	34.66	39.66
	Vernalization	30.65	35.01	1.841	2.058	0.368	0.411	36.66	39.00
	Control	23.41	26.09	1.758	1.866	0.351	0.369	29.00	31.00
LSD at 0.05 %		2.314	2.759	0.083	0.093	0.015	0.016	2.600	2.909

Br: brassinolide andMix: (gibberellic acid 2.5 %, chlorophenoxy acetic acid 2.5 % and naphthalene acetic acid 2.5 %).

The superiority of brassinolide might be due to its role in accelerating formation of flowers and fruits as a result of increasing the endogenous auxins, to enhancement pod set (Susila *et al*., 2012).

Similar results were registered by Matwa *et al*. (2017) and El-Sayed a *et al*. (2019a) on brassinolide, Husain *et al*. (2018) and Thomson *et al*. (2017) on growth regulators, Zewail *et al*. (2019) and El-Sayed *et al.* (2019b) on potassium silicate, Abd-Elrhem (2017) and El-Sayed b *et al*. (2019) on yeast, Jadhav *et al.* (2019) and Bangar *et al*. (2019) on potassium nitrate and Al-Ubaid and Mohammed (2018) on vernalization.

3-Seed quality:

A-Effect of sowing dates:

The results for reducing, non reducing total sugars, carbohydrates, and protein percentages of green seeds as affected by planting dates presented in Table (8). It is clear from the data in the same table, there were significant differences between the two planting dates (20th January and 20th February) regarding to reducing, non reducing and total sugars in both seasons of the study. Sowing seeds on 20th January gave the highest values of Reducing, non reducing and total sugar percentages of seeds more than sowing on 20 February in both years.

The obtained results confirmed the superiority of 20th of January planting date during the two seasons of study. The highest carbohydrate percentage (46.93 and 49.32%) resulted from green seed of plants sowed in 20th January in the first and second seasons respectively. As for protein percentage, the results show that in second season insignificant difference between the effect of January and February planting. But in the first season there were significant differences between the two planting dates (20th January and 20th February) of pea.

Table 8. Effect of planting date on reducing sugar, non reducing, total sugar , carbohydrate and protein of pea seeds during 2018 and 2019 late winter seasons.

Characters	Reducing sugar %		Non reducing Sugar %		Total sugar %		Carbohydrate %		Protein %	
Treatments	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
20 th January	2.82	2.85	8.92	9.01	11.74	11.86	46.93	49.32	16.30	17.25
20 th Februar	2.73	2.75	8.81	8.86	11.54	11.61	44.97	47.19	16.04	16.39
LSD at 5 %	0.010	0.007	0.028	0.026	0.169	0.074	0.051	0.091	0.121	2.297

High temperature at the late date affecting nutrients absorption and reduced the grain growth duration resulted in the reduction of protein contents. While in the early date, the temperature was relatively better which helped out in getting good quality of pea seeds with maximum protein contents (Shaukat *et al*., 2012). In this context, Szczepanek and Olszewski (2009) showed that the delay of sowing resulted in reduction in chlorophyll content and the rate of photosynthesis and of leaves. These results are similar to that recorded by Ali *et al*. (2016), El-Shafey *et al* .(2016) and Sumalatha and Uppar (2019).

B-Effect of foliar application and vernalization practice:

Concerning the effect of foliar application and vernalization treatments on chemical composition of pea green seeds, the results in Table (9) prove surpass all foliar substance and vernalization treatments with respect to reducing, non reducing total sugars, carbohydrates, and protein percentages of green seeds compared to control plants. The highest significant values were recorded when pea plants sprayed with brassinolide at the rate of 10 mg/l, followed by yeast extract at 10gm/l , mix at 1cm/l and potassium nitrate at the rate of 2g/ Lcompared with rest substance and vernalization treatments in both seasons of study.

Table 9. Effect of foliar application and vernalization treatments on reducing sugar, non reducing, total sugar ,carbohydrate and protein of pea seeds during 2018 and 2019 late winter seasons.

Characters	Reducing sugar %		Non reducing Sugar %		Total sugar %		Carbohydrate %		Protein %	
Treatments	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Br 5 ppm	2.87	2.93	8.96	9.07	11.83	12.00	46.65	48.97	17.00	17.53
Br 10 ppm	3.17	3.25	9.15	9.22	12.32	12.47	48.90	50.53	18.75	19.60
Mix 0.5 ppm	2.54	2.64	8.80	8.88	11.34	11.52	45.12	47.76	15.36	16.23
Mix 1 ppm	3.17	3.04	8..98	9.15	12.15	12.19	47.73	49.71	17.83	18.68
Yeast 5 g/L	2.54	2.58	9.00	8.76	11.54	11.34	44.97	47.76	15.05	15.95
Yeast 10 g/L	3.11	3.13	9.11	9.19	12.22	12.32	48.39	50.03	18.26	18.88
KNO_3 1 g/L	2.78	2.73	8.88	9.01	11.66	11.74	46.15	48.14	16.41	17.82
KNO_3 2 g/L	3.05	2.95	8.96	9.04	12.01	11.99	47.27	48.58	17.51	18.18
K_2SIO_3 2.5 g/L	2.42	2.58	8.59	8.71	11.01	11.29	43.68	46.69	13.95	15.45
K_2SIO_3 5 g/L	2.47	2.58	8.68	8.80	11.15	11.38	44.07	46.82	14.53	15.50
Vernalization	2.82	2.89	8.80	8.84	11.62	11.73	45.53	48.19	15.85	16.70
Control	2.38	2.44	8.48	8.59	10.86	11.03	42.97	46.26	13.56	14.85
LSD at 0.05 %	0.136	0.106	0.252	0.134	0.307	0.120	0.218	0.157	0.195	2.510

Br: brassinolide and Mix: (gibberellic acid 2.5 %, chlorophenoxy acetic acid 2.5 % and naphthalene acetic acid 2.5

C-Effect of the interaction :

Table (10) show that all interaction between planting dates and foliar applications plus vernalization increased reducing, non-reducing and total sugar percentages of pea green seeds in both seasons. The interaction between sowing on 20th January and spraying with brassinolide at 10 mg/l recorded the highest values followed by yeast extract at 10 g/l, mixture at 1cm/l and potassium nitrate at 2gm/l.

Moreover, The interaction between sowing on 20th January and spraying with brassinolide at 10 mg/l followed by yeast extract at 10 g/l mixture at 1cm/l and potassium nitrate at 2gm/l gave the highest values of carbohydrates percentage in descending order compared with other studied interactions in both seasons. Generally, all interactions significantly increased the studied carbohydrates percentage compared with control.

Otherwise, data in the same table show that, most interaction between planting dates and foliar applications plus vernalization increased the protein percentage of green seeds of pea plant in both seasons. The highest protein percentage obtained from interaction between sowing on 20th January and spraying with brassinolide at 10 mg/l followed by yeast extract at 10 gm/l, brassinolide at 10 mg/ l.

Concerning seeds content of carbohydrate, reducing, non-reducing and total sugar and protein, The results showed that protein characters responded well to foliar and vernalization treatments compared with control. The highest chemical contents in seeds were recorded when pea plants sprayed with brassinolide at rate 10 mg/l followed by yeast extract at 10 gm/l.

Brassinolide increase NO3-absorption and nitrate reeducates activity consequently led to increase in N content, total free amino acid, protein and carbohydrates content in pods (Vardhini and Rao, 1998, Ali *et al*. 2006 and Fariduddin *et al.*, 2008).

From the obtained results of this research, it can be recommended that sowing pea seeds cv. Master-B on 20 th January and spraying with brassinolide at 10 mg/l and potassium nitrate at 2gm/l gave the highest values of yield and its component and green seeds quality during the late winter planting under the environmental conditions of the study.

Table 10. Effect of interaction between sowing date and foliar application and vernalization treatments on reducing sugar, non reducing, total sugar , carbohydrate and protein of pea seeds during 2018 and 2019 late winter seasons.

Characters		Reducing Sugar %		Non Reducing Sugar %		Total Sugar %		Carbohydrate %		Protein %	
Treatments		2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
20 th January	Br 5 ppm	2.92	2.98	9.01	9.14	11.93	12.12	47.73	48.33	17.06	17.63
	Br 10 ppm	3.22	3.31	9.22	9.32	12.44	12.62	49.83	51.46	18.96	19.86
	Mix 0.5 ppm	2.58	2.70	8.85	8.95	11.43	11.65	46.17	48.74	15.53	16.40
	Mix 1 ppm	3.09	3.20	9.03	9.23	12.12	12.43	48.75	50.73	18.00	18.86
	Yeast 5 g/L	2.58	2.63	8.83	9.05	11.41	11.68	45.64	48.33	15.10	16.06
	Yeast 10 g/L	3.17	3.17	9.08	9.27	12.25	12.44	49.26	51.05	18.40	19.33
	KNO_3 1 g/L	2.78	2.83	8.94	9.07	11.72	11.90	47.24	49.53	16.53	17.33
	KNO_3 2 g/L	3.01	3.11	9.02	9.12	12.02	12.23	48.23	50.32	17.56	18.26
	K_2SIO_3 2.5 g/L	2.48	2.49	8.64	8.74	11.12	11.23	45.12	47.53	14.10	15.56
	K_2SIO_3 5 g/L	2.50	2.63	8.73	8.87	11.23	11.50	44.56	47.94	14.53	15,80
	Vernalization	2.87	2.95	8.85	8.94	11.82	11.89	46.65	49.13	16.06	16.90
	Control	2.44	2.49	8.53	8.66	10.97	11.15	44.05	47.25	13.80	14.96
20 th February	Br 5 ppm	2.82	2.88	8.91	9.01	11.73	11.89	45.57	47.99	16.93	17.43
	Br 10 ppm	3.09	3.18	9.08	9.11	12.17	12.29	47.98	49.60	18.53	19.33
	Mix 0.5 ppm	2.51	2.59	8.75	8.80	11.26	11.39	44.08	46.79	15.20	16.06
	Mix 1 ppm	2.99	3.12	8.93	9.07	11.92	12.19	46.71	48.70	17.66	18.5
	Yeast 5 g/L	2.50	2.53	8.93	8.69	11.43	11.22	44.31	46.38	15.00	15.83
	Yeast 10 g/L	3.06	3.17	9.05	9.10	12.11	12.27	47.52	49.01	18.13	18.80
	KNO_3 1 g/L	2.78	2.67	8.83	8.93	11.61	11.60	45.07	47.96	16.30	17.23
	KNO_3 2 g/L	3.05	2.90	8.91	8.97	11.06	11.87	46.31	48.40	17.46	18.10
	$K_2SIO_3$2.5 g/L	2.42	2.42	8.54	8.67	10.96	11.09	42.80	45.70	13.80	15.10
	K_2SIO_3 5 g/L	2.47	2.53	8.63	8.73	11.10	11.26	43.01	45.86	14.53	15.43
	Vernalization	2.82	2.84	8.74	8.73	11.56	11.57	44.41	47.25	15.63	16.50
	Control	2.38	2.38	8.43	8.52	10.81	11.90	41.88	45.38	13.33	14.73
LSD at 0.05 %		0.136	0.101	0.357	0.190	0.434	0.170	0.308	0.222	0.276	3.550

Br: brassinolide and Mix: (gibberellic acid at 2.5 %,4- chlorophenoxy acetic acid at 2.5 % and naphthalene acetic acid at 2.5 %).

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بعض الممارسات الزراعية لتحسين النمو والمحصول والجودة للبسلة المنزرعة في العروات المتأخرة

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تم تنفيذ هذا العمل في المزرعة البحثية بالبرامون ، التابعة لمحطة بحوث البساتين بالمنصورة ، معهد بحوث البساتين ، مركز البحوث الزراعية ، خلال العروة الشتوية المتأخرة لموسمي الزراعة 2018 و 2019 على نبات البسلة صنف ماستر لدراسة تأثير ميعادين للزراعة هما (20 يناير و 20 فبراير) ، بالإضافة الى الرش بالبراسينولايد بتركيز (5،10مجم / لتر) ، خليط من منظمات النمو (0.5 و 1 سم / لتر) ، مستخلص الخميرة (5 و 10 جم / لتر) ، نترات البوتاسيوم (1 ، 2 جم / لتر) سيليكات البوتاسيوم (2.5 ، 5 جم / لتر) بالإضافة إلى عملية الارتباع وكذلك التفاعل بينهم على النمو والمحصول مكوناته وبعض الصفات الكيماوية للبذور الخضراء. أوضحت النتائج التي تم الحصول عليها أن الزراعة في الميعاد الاول (20 يناير) حققت ارتفاع قيم النمو المتمثلة في (طول النبات ، والمساحة الورقة ، الوزن الطازج والوزن الجاف للنبات) ، وزيادة المحصول و مكوناته (نسبة التصاقي ، ومحصول القرون / النبات ، محصول القرون الطازج والمحصول البذور الجاف للفدان) بالإضافة الى تحسين محتوي للبذور الخضراء متمثلا فر زيادة النسبة المئوية لكل من (السكريات المختزلة وغير المختزلة والكلية، الكربوهيدرات و البروتين). تأثرت جميع الصفات المختبرة بشكل كبير بمعاملات الرش الورقية و ممارسة الارتباع في كلا الموسمين مقارنة بالكنترول. حققت معاملة الرش بالبراسينولايد بمعدل 10 مجم / لتر افضل نمو واعلى محصول ومكوناته واحسن تركيب كيمياوي. ، يليها نترات البوتاسيوم بمعدل 2 جم / لتر ، خليط منظمات النمو بمعدل 1 سم / لتر ثم مستخلص الخميرة بمعدل 10 جم / لتر. كانت معاملة التفاعل بين زراعة بذور البسلة ماستر بي في 20 يناير و الرش الورقي بمركب البراسينولايد بتركيز 10 مجم / لتر أفضل المعاملات فيما يتعلق بالنمو ومكونات المحصول والتركيب الكيميائي . في حين ان معاملات التفاعلات الأخرى سجلت قيما متوسطة للصفات المذكورة سابقاً ، بينما كانت اقل القيم ناتجة عن التفاعل بين ميعاد الزراعة الثاني (20 فبراير) ومعاملة الكونترول. من النتائج التي تم الحصول عليها ، يمكن التوصية بزراعة البسلة صنف ماستر بي في 20 يناير والرش الورقي باستخدام مركب البراسينولايد بتركيز 10 مجم / لتر أو الرش بنترات البوتاسيوم بمعدل 2 جم / لتر ، أو خليط منظمات النمو بمعدل 1 سم / لتر أو مستخلص الخميرة بمعدل 10 جم / لتر لزيادة النمو والمحصول والتركيب الكيميائي للبسلة المنزرعة في ظروف التجربة والظروف المماثلة لها خلال العروة الشتوية المتأخرة في نطاق الدراسة .