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Effect of Sowing Dates, Irrigation Intervals and Organic Fertilizers on Growth and Productivity of Pea Plants (*Pisum sativum* L.) under Sandy Soil Conditions

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ABSTRACT

Two field experiments were conducted during winter seasons of 2014-15 and 2015-16 at the Agric. Res. Station, Veg. Res. Dept., Hort. Res. Inst., Agric. Res. Center, in El- Arish, North Sinai Governorate, Egypt. The aim of this investigation to study the effect of two sowing dates (15th October., and 15th November), two irrigation treatments (100% for water requirements for pea , which is 2100 m^3 distributed through the growth stage to irrigation every day and irrigated every two days by half of these requirements) and five fertilization treatments (100% NPK from recommended dose as control, Cow manure, and Compost at rates of 10 and 20 m^3 per fed. from each) on Sementi Pea (*Pisum sativum* L.) cultivar growth and yield under sandy soil condition with drip irrigation system. The treatments were arranged randomly in a split-split -plot design, in three replications where the two sowing dates were randomly arranged in the main plots, two irrigation intervals were randomly distributed in sub plots., and five fertilization treatments were allotted in sub sub plots. The results showed that the highest values of all growth parameters; i.e., plant height, number of branches, number of leaves as well as the fresh and dry weight of pea plants, recorded at the first sowing date (15th October) and irrigation every day with addition of compost at the rate of 20 m^3 or 10 m^3 per fed. Followed by sowing in the same date and the irrigation every two days with addition of compost at the rate of 20 m^3 per fed. The results indicated that the first sowing date (15th October) of pea plants with irrigation every day or every two days and adding organic fertilizer from compost at the rate of 20 m^3 per fed recorded the highest values of number of pods per plant, number of seeds per pod, pod length, and yield per plant as well as total yield per fed. Followed by planting in the same date with irrigation every day and adding of compost fertilization at the rate of 10 m^3 per fed. Also, the results showed that the highest values for leaf content of photosynthetic pigments as well as the seed content of N P K and protein were obtained from sowing on 15th October and irrigation each day with adding compost fertilizer at the rate of 20 and 10 m^3/ fed. Followed by sowing on the same date with irrigation every two days and adding 20 m^3 of compost /fed. Regard to the water relations, resulted indicated that, irrigation of pea plants every two days during the different stages of growth reduced the total yield by 17.29 - 17.06 % , and saving about 2.86 - 3.09 % of (IWR) in the two growing seasons, respectively. In addition, increasing all investigated organic fertilizer rates with lowering of amount water irrigation led to water saving more than 24%. Among these results, it is clear that the highest value of water use efficiency (5.96 and 6.40 kg/m^{-3}) in the first and second season, respectively was obtained with application of the doubled amount compost (20 m^3 per fed.) with irrigation every two days under sandy soil condition in North Sinai location.

INTRODUCTION

Pea (*Pisum sativum* L.) is one of the major winter crops grown in Egypt for local consumption and export. It is highly nutritious due to its important bio-chemical attributes, viz., protein content, protein quality (having good amount of essential amino acids such as lysine, methionine, leucine etc… which are not synthesized by the human body), minerals, oils and sugar content. Peas are highly nutritive and contain a high percentage of digestible (22.5% proteins, 58.5% carbohydrates, 1.0% fats, 4.4% fibers and 3% minerals vitamins, particularly of the B group) Gheeth *et al*. (2012).

Pea plants affected greatly by unfavorable environmental conditions such as water stress, frost and high temperature salter (1963). Growth and productivity of the plants are affected due to many abiotic stresses like salinity, heat, cold and drought etc. Sana *et al*. (2016). It is known that the soil in North Sinai region mostly is sandy or sandy calcareous, which is very poor in organic matter content and its nutrients. In addition it has low-water holding capacity and therefore it required addition of organic fertilizer because of its significant role for overcome various problems of these types of soil, for increasing organic matter in sandy soil, it was recommend to adding organic fertilizers, as compost form chicken manure or cow manure as source for nitrogen fertilizer and also for enhancing soil quality,

Water supply is a major constraint for crop production in the North Sinai region. As fruit or seed yield with dependence on the water supply it is a critical issue because of the increasing limited water resources for irrigation. The underground water is the main source of irrigation through using drip irrigation system (Abuo El-kasem 2017; Abuo El-kasem 2016a).

The optimal planting date is necessary to attain the optimal yield. Planting date is the most important factor that affects the physiological and morphological properties of plants Akramghaderi (2003).

Irrigation water should be applied adequately during plant growth stages Ahmed (1991). Delaying irrigation causes falling of the flowers and reduces early-formed fruits. Increasing irrigation will increase the vegetative growth. However, it can increase water-use efficiency of a crop by reducing evapotranspiration and minimizing leaching into underground water. Water is the solvent in which gasses, minerals, and other solutes enter plant cells and move from organ to organ. It is a reactant in many important biochemical processes, including photosynthesis and hydraulic processes. Another role of water is in the maintenance of turgor, which is essential for cell enlargement and growth Kramer and Boyerb (1995).

Adequate nutrition is the ecosystem response to the addition of artificial or natural substances, in addition to providing necessary for crops and improving soil physic-chemical properties, organic fertilizer is able to enhance soil microbial activity through improving activity of soil enzymes and increasing soil microbial biomass Sun *et al*. (2003). Also, Vorasoot *et al*. (2003) and El- Boraie *et al*. (2009) concluded that under stress condition, the yield was decreased, and these effects might be due to that in organic fertilizers system a set of soil microorganisms processing the ability of mobilizing the unavailable forms of nutrient element to available forms has been successfully.

Many investigators indicated the relations between irrigation water and organic fertilizers, where the use of organic fertilizers increased the crop productivity, soil fertility and decreased the water requirements with using compost "saving water" (Sun *et al*., 2003, Ati *et al*., 2013, and Natsheh and Mousa, 2014).

The objective of this work was to study the effect of sowing dates, irrigation intervals, and rates of organic fertilizers on growth and productivity as well as water relations for pea plants under North Sinai conditions.

MATERIALS AND METHODS

Two field experiments were carried out in the winter seasons of 2014-15 and 2015-16 at the Experimental Agric. Res. Station Veg. Res. Dept., Hort. Res. Inst., Agric. Res. Center, in El- Arish, North Sinai Governorate, Egypt. The aim of this work was to study the effect of two sowing dates (15th October., and 15th November), two irrigation intervals (every day and every two days) and five fertilization treatments (100% of NPK from recommended dose as control, Cow manure, and Compost at rates of 10 and 20 m^3 per fed. from each) on Sementi pea (*Pisum sativum* L.) cultivar growth and yield.

The treatments were arranged randomly in a split-split plot design with three replications. Sowing dates were randomly arranged in the main plots while, irrigation intervals were distributed in sub plots, and fertilization treatments were allotted in sub sub plots.

The total amount of irrigation water requirements for pea plants was 2100 m3/fed./season. Every growing growth stage had its own requirements of irrigation water according to the recommended doses for pea plant (Doorenbos and Pruitt, 1981). Irrigation treatments were carried out by adding every day or every two days (by the same amount of water that added for irrigation every day treatment and half amount for irrigation every two days). The irrigated water applied added was estimated using gauge.

The experimental unit was 12.50 m^2 (5 m length x 2.5 m width) contained five dripper lines. Seeds were sown in two rows besides each dripper line with a distance of 10 cm between hills in the same row.

The physical and chemical of the soil and irrigation water as well as analysis of the two sources of organic fertilizers were presented in Tables 1, 2, and 3, respectively determinations were carried out according to the method of Ryan *et al*. (1999).

Table 1. physical and chemical properties of the experimental soil.

Mechanical analysis %			Chemical analysis (soluble ion in (1:5 extract)														
Sand	silt	clay	Total (ppm)				meq.1^{-1}								ECe	pH	Organic matter %
							Cations				Anions						
88.9	5.3	5.8	N	P	K	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$So^{-}4$	Cl^{-}	Co_3	HCO_3	Ca Co_3			
Soil texture (Sand)			13	35.2	37.4	3.0	4.0	2.45	2.5	1.45	3.3	-	0.4	0.2	0.52	7.97	0.08

Table 2. Some chemical analysis of water irrigation used.

pH	EC (dSm^{-1})	Soluble ions(meq.1-1)								S.A.R.
		Cations				Anions				
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	Co_3^{-}	SO_4^{-}	
7.52	2.40	7.12	6.30	8.30	0.60	11.50	2.55	-	8.27	11.42

Table 3. Some chemicals analysis of organic fertilizer studded .

Organic sources		Total (%)			Total (ppm)				Organic matter %	Organic carbon %
		N	P	K	Fe	Cu	Zn	Mn		
caw manure	2014-15	1.48	0.16	0.16	324	230	115	129	30.35	18.71
	2015-16	1.50	0.24	0.22	346	228	109	133	33.65	20.34
Compost	2014-15	1.51	0.22	0.80	350	250	187	244	33.22	23.36
	2015-16	1.56	0.24	0.78	345	264	192	227	35.12	26.35

Data recorded:

1. Vegetative growth:

A random sample of 15 plants from each sup-sup plot was taken at 90 day after sowing to measure the following vegetative growth i.e. plant height (cm), the number of both branches and leaves as well as total fresh and dry weight of all plant organs.

2. Yield and its components

Green yield was estimated as follows: Number of pods per plant, number of seeds per pod, pod length (cm) pods yield per plant (g), and seed yield (ton/fed.);

3. Chemical constituents of pea leaves and seeds

1. **Photosynthetic pigments:** Chlorophyll a, and b were determined according to the method described by Moran (1982).

2. Chemicals seeds constituent:

1. Total nitrogen was determined by using the method described by (Bremner, and Mulvancy, 1982),
2. Phosphorus content was determined using the method described by Ryan *et al*. (1999),
3. Potassium was determined photometricaly according to Hesse (1971).

4. Total protein % was calculated by multiplying nitrogen content by 6.25.
5. Total carbohydrates content was determined calorimetrically according to methods described by Michel *et al*. (1956).

4. Plant water-relations

1. Consumptive use of water (CU): It was calculated using the equation given by (Israelson and Hansen, 1962) as follows:

$$CU = D \times AD \times \frac{e_z - e_i}{100}$$

Where:

CU=Consumptive use of water in cm,
D=Irrigated soil depth in cm,
AD=Bulk density, gm cm^{-3}, of the chosen irrigated soil depth,
e_z=Soil moisture percent after irrigation, and
e_i=Soil moisture percent before the next irrigation.

2. Water use efficiency (WUE): The consumed water by cowpea plant was calculated according to Yaron *et al*. (1973) as follows:

$$WUE = \frac{Y}{ET_a}$$

Where:

Y = Crop yield (kg.fed^{-1}.), and
ET_a=Evapotranspiration (m^3.fed^{-1}.)

The actual evapotranspiration, ET_a, is assumed to be synonymous to the calculated consumptive use of water (CU). Consequently, daily and monthly consumptive use of water was calculated for specified soil depths for all treatments.

3. The yield reduction and increasing and water saving were calculated from the following equations:

$$\text{Reduction in yield} = \left(100 - \frac{\text{Yield of other treatments}}{\text{Yield of control treatment}}\right) \times 100$$

$$\text{Increasing in yield} = \left(100 - \frac{\text{Yield of control treatment}}{\text{Yield of other treatments}}\right) \times 100$$

$$\text{Water saving} = \left(100 - \frac{\text{Water consumption of other treatments}}{\text{Water consumption of control treatment}}\right) \times 100$$

5. Statistical analysis: Statistical analysis of the obtained data was carried out according to statistical analysis of variance according to (Snedecor and Cochran, 1980). Duncan's multiple range tests was used for comparison among the means Duncan (1958). The M stat C program was used for analysis.

RESULTS AND DISCUSSION

1. Plant growth

1. Effect of sowing dates

The data in Table 4 and; fig.1, 2, 3, and 4 show significant effects on most studied traits i.e. plant height, the number of leaves as well as the fresh and dry weight of pea plants, except the number of branches in both seasons.

The first sowing date (15th October) of pea plants gave the highest values for plant height, number of leaves as well as fresh and dry weight compared to the second sowing date (15th November) in both seasons. Regard to the mean of air temperature during growth stage in the first sowing date (17.63 and 16.54 ^{0}C), solar radiation (3.52 and 5.22 mJ/m^2), relative humidity (75.19 and 71.15 %), and soil temperature (19.83 and 19.2^{0}C) and in the second sowing date the air temperature recorded (14.81 and 14.56^{0}C), solar radiation (3.70 and 5.15 mJ/m^2), relative humidity (72.50 and 72.75%), and soil temperature (16.26 and 16.21^{0}C) in the first and second seasons respectively under El- Arish region conditions. The data in fig.1, 2, 3, and 4 indicated highest values of the means in most studied characters for the first sowing date compared to the second sowing date in both seasons; except the mean of solar radiation for the first sowing date was low then the second sowing date in the two growing seasons. In addition, the relative humidity recorded the lowest mean values for first sowing date in the second season alone. The ideal mean temperature for growth is 55–65°F (13–18°C). Young pea plants can withstand a little frost, though frost may damage the flowers and pods. As a winter crop, peas tolerate temperatures down to 28°F (-2°C) in the seedling stage, but top growth may be damaged when the temperature falls below 21°F (-6°C) Slinkard *et al*. (1994). Also, increasing the relative humidity from 70 to 90 per cent at 20 °C increased dry weight of (mainly leaves and stems), and shoot numbers of wheat plant by 20-30 per cent Margaret *et al*. (1974) This confirms the results obtained by Sharma et. al. (2014) on *Pisum sativum*, who found that when sowing pea plant in the early date (31th October) it gave the highest values from primary branches per plant and plant height (cm) compared to the late dates (10th or 21th November).

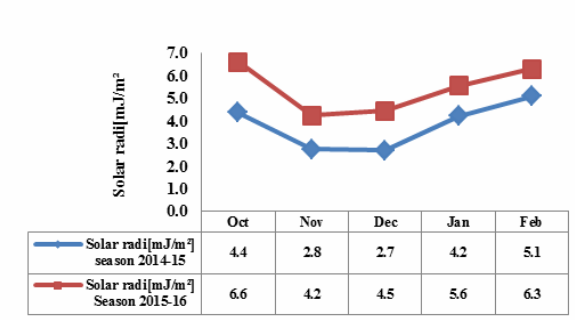
2. Effect of irrigation intervals

The data in Table 4 show that application of irrigation intervals (irrigation every day and every two days) had significant effects on most studied traits; i.e., plant height, the number of leaves as well as the fresh and dry weight of pea plants, except the number of branches in both seasons. Application of irrigation every day gave the highest values for plant height, number of leaves, as well as fresh and dry weight, compared to irrigation every two days in both seasons. In this respect Embiale *et al.* (2016) on *Pisum sativum* plant, studied the adding of irrigation water every 3 day intervals to maintain 100% field capacity and exposure of plants to water-stress through irrigated at 6 day intervals (slight-stress condition), 9 day intervals (mild-stress condition) and 12 day intervals (severe-stress condition). The water-stress treatments (6, 9 and 12 days intervals) were recorded the lowest values of plant height, number of leaves, number of branches, leaf area, total biomass as well as leave length and width compared to irrigation every 3 days intervals to maintain the100% of field capacity. They also found no significant effect on the number of branches for pea plants.

3. Effect of organic fertilization rates

Data presented in Table 4 indicate that increasing organic fertilization rates from cow manure and compost recorded the highest values on most studied traits of plant height, the number of leaves as well as the fresh and dry weight of pea plants compared to 100% NPK from recommend dose (control) treatment. Application of compost at the rate of 20 m^3 per fed. gave the highest values of previous measurements of pea plants with no

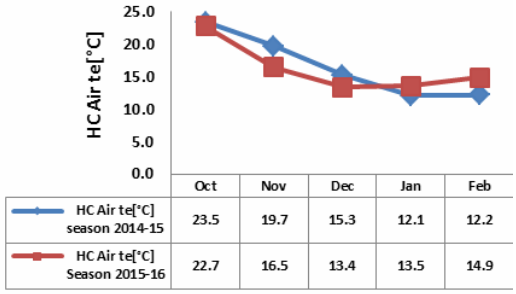
significant difference than the addition rates of 20 or 10 m^3 per fed. on most studied traits in both seasons. These results are in harmony with those found by Hirich et. al. (2014) on pea plant, who reported that the application of compost at the rate of 10 t ha^{-1} has improved dry matter accumulation compared to 0 and 5 t ha^{-1}, respectively. The application of cow dung at 15 t ha^{-1} showed significant growth over the inorganic fertilizer urea and potassium chloride in terms of germination percentage, plant height, shoot length, and root length, number of leaves as well as fresh and dry weight for both legume plants namely faba bean and pea plants Chinthapalli *et al*. (2015).



Mean of Solar radiation [mJ/m²] for four months during growth stages of the pea plant

season	2014-15	2015-16
First sowing date	3.52	5.22
Second sowing date	3.70	5.15

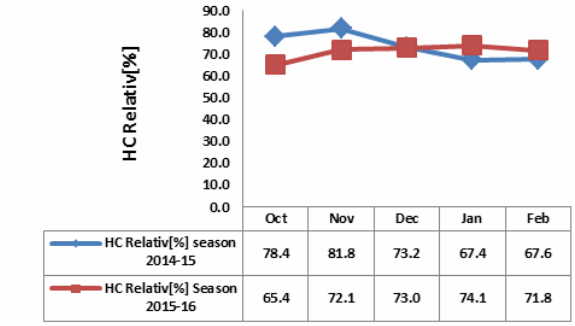
Fig. 1. Average of solar radiation during growth stages of pea plants.



Mean of Air temperature[°C] for four months during growth stages of the pea plant

season	2014-15	2015-16
First sowing date	17.63	16.54
Second sowing date	14.81	14.56

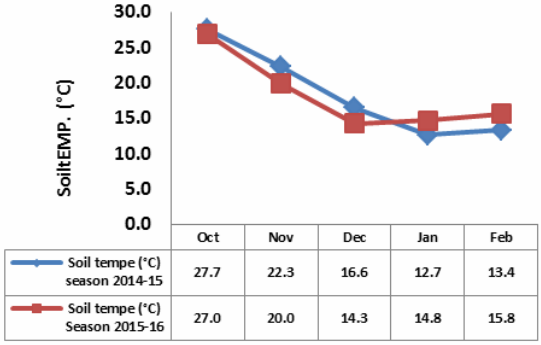
Fig. 2. Average of air temperature during growth stages of pea plants.



Mean of relative humidity [%]for four months from growth stages of the pea plant

Season	2014-15	2015-16
First sowing date	75.19	71.15
Second sowing date	72.50	72.75

Fig. 3. Average of Relative humidity during growth stages of pea plants



Mean of soil temperature (°C)for four months from growth stages of the pea plant

season	2014-15	2015-16
First sowing date	19.83	19.02
Second sowing date	16.26	16.21

Fig. 4. Average of Soil temperature during growth stages of pea plants.

4. Effect of the interaction between sowing dates and irrigation intervals

The data in Table 4 show significant effects of the interaction between sowing dates and irrigation intervals on most studied traits; i.e., plant height, the number of leaves as well as the fresh and dry weight of pea plants, except, number of branches in the first season. In general, the highest values of the previous characters were recorded with the first sowing date (15th Oct.) and the addition of irrigation every day. These resulted were observed in the two growing seasons. The increment in plant growth may be due to influence of soil temperature, the mean of soil temperature had the highest values in the first sowing date compared to the second (15th Nov.) date as shown fig. (4). Soil temperature also affects the energy absorbed thus, resulted in improvement of soil water relations (water use efficiency and water saving) (Table 13) which reflected on vital and metabolism processes of transmission and availability for enhancement the plant growth. In support of these findings Asadipour and Madani (2014) on okra plants, found that that the interaction between sowing date (30 April, 7 May, 14th May, 21th May and 28th May) and Irrigation intervals increased were 5, 7 and 10 days. The okra planting in early date (from 30th April to 14th May) and irrigation frequent at 5 days recorded the highest values of stem length, stem diameter, number of branches and branches per plant compared to the late sowing and irrigation intervals 7 and 10 days.

5. Effect of the interaction between sowing dates and organic fertilization rates

The data in Table 4 show significant effects of the interaction between sowing dates and organic fertilization

rates on all studied traits of pea plants, the highest values of all studied traits; i.e., plant height, number of branches, number of leaves as well as the fresh and dry weight of pea plants were recorded with the first sowing date (15th October) and application rate of 20 m^3 per fed. from compost manure in both seasons, followed by the same first sowing date with addition of 10 m^3 of compost or the second sowing date (15th Nov.) with adding compost at a rate of 20 m^3 per fed for plant height, number of branches as well as fresh and dry weight in the both seasons. The increase of fresh and dry weight of pea plant when planting in the first sowing date and received the rate of 20 m^3 per fed. from compost may be due to the increase in air and soil temperature in the first sowing date compared to the second sowing date as well as the increase in organic matter and nitrogen content in compost fertilization as shown in fig. 2 , 4 and Table 3. Increase in soil temperature increases the soil nitrogen mineralization rates through the increase in microbial activity and increase in the decomposition of organic matter in the soil Yan and Hongwen (2014).

6. Effect of the interaction between irrigation intervals and organic fertilization rates

The data in Table 5 show significant effects for the interaction between irrigation intervals and organic fertilization rates on all studied traits in both seasons. The irrigation every day and application of 20 m^3 per fed. or adding of 10 m^3 per fed. from compost manure followed by irrigation every two days with addition of 20 m^3 per fed. from compost manure recorded the highest values for plant height, number of branches, number of leaves as well as the fresh and dry weight of pea plants in the two growing seasons. These results agree with those of El-Tantawy (2017) on cowpea, who found that the highest values in plant height and total dry weight of cowpea plant were obtained by the irrigation every day and fertilization by compost at a rate of 6 ton per fed. with the intercropping pattern of 100: 72.72 compared to the other treatments.

7. Effect of the interaction among sowing dates, irrigation intervals and organic fertilization rates.

Data presented in Table 6 show significant effects of the interaction among the sowing dates, irrigation intervals and organic fertilization rates on all studied traits; i.e., plant height, number of branches, number of leaves as well as the fresh and dry weight of pea plants .The highest values were recorded at sowing in the first date (15th Oct.) and irrigation every day with addition of compost manure at the rate of 20 m^3 per fed. or addition of 10 m^3 compost followed by sowing in the first date and the irrigation every two days with addition of compost manure at the rate of 20 m^3 per fed.

2. Yield and its components

1. Effect of sowing dates

Data in Table 7 show significant effects for the sowing dates on most studied traits of pea plants in both seasons, data in the table indicate that the cultivation of pea plants in the first date (15th October) gave the highest values for yield and its components of pea plants; i.e., number of pods per plant, number of seeds per pod, pod length (cm), and yield per plant (g) as well as yield per fed.(ton). These results are similar with the results obtained by Sharma *et al*. (2014) on *Pisum sativum*, found that pea plant when sowing in the early date (31th October) gave a significantly increase of seed yield, biomass yield, pods/plant, seeds pod and pod length as well as 100 seed weight compared to late sowing in the 10 th and 21 th November.

2. Effect of irrigation intervals

The data in Table 7 show significant effects concerning to the irrigation intervals on all studied traits in both seasons. The highest values for all studied traits i.e.., number of pod per plant, number of seeds per pod, pod length, and yield per plant as well as total yield per fed. were recorded with the irrigation every day in both seasons. These resulted may be due to increases in plant growth and its organs during growth stages, it is obvious achieved when irrigation every day (Table 6) which increased the accumulation of dry matter, consequently, it can reflect an increase of yield and its components for pea plant. These results are in harmony with Roshdi *et al*. (2006) on sunflower, who indicated that with increasing irrigation intervals head diameter, seed yield was decreased.

3. Effect of organic fertilization rates

The data in Table 7 show significant effects of the organic fertilization rates on yield and its components in both seasons, addition of compost fertilizers at the rate of 20 m^3 followed by the rate of 10 m^3 gave the significant increases of yield and its components expressed number of pods per plant, number of seeds per pod, pod length, and yield per plant as well as total yield per fed. in the both seasons. Khairy (2007) on pea plant, found that yield and its components (pod length, number of pods per plant, pod weight, yield per plant, yield per fed., number of seeds per pod) were significantly increased with the high rates from 15 up to 30 m^3 per fed. of organic manure.

2.4 Effect of the interaction between sowing dates and irrigation intervals

The data in Table 7 show that, the interaction between sowing date and irrigation intervals had a positive effect on all studied traits of the yield and its components; for pea plants in both seasons. The highest values of total yield and its components; i.e.., number of pods per plant, number of seeds per pod, pod length, and yield per plant as well as yield per fed., were recorded with planting of pea plants in the first date (15th Oct) and irrigation every day in both seasons. Asadipour and Madani (2014) on okra plants, found that that the interaction between sowing date (30th April, 7th May, 14th May, 21th May and 28th May) and irrigation intervals increased were (5, 7 and 10 days). The okra planting in early date (from 30th April to14th May) and irrigation at 5 day recorded the highest values of pod length, number of pods per plant, and fresh pod length compared to the late sowing date and irrigation intervals of 7 and 10 days.

Table 4. Effect of sowing dates, irrigation intervals and organic fertilizers on plant height, number of branches, number of leaves, fresh and dry weight of pea plants during 2014-15 and 2015-16 seasons.

Characters / Variables		Plant height (cm)	No. Branches	No. Leaves	Plant fresh weight (g)	Plant dry weight (g)
90 Days from sowing						
Effect of sowing dates			Season 2014-15			
15th Oct.		51.52a	3.32a	27.93a	41.94a	17.09a
15th Nov.		45.68b	3.01a	13.98b	36.02b	12.98b
			Season 2015-16			
15th Oct.		52.55a	3.75a	32.08a	46.74a	20.45a
15th Nov.		47.22b	3.57a	18.74b	41.91b	16.27b
Effect of irrigation intervals			Season 2014-15			
Every day		49.95a	3.29a	23.45a	43.19a	16.13a
Every two days		47.25b	3.04a	18.46b	34.76b	13.95b
			Season 2015-16			
Every day		52.18a	4.02a	27.19a	49.20a	19.31a
Every two days		49.30b	3.30a	23.63b	39.45b	17.42b
Effect of fertilizers rates			Season 2014-15			
Control		42.29b	1.91c	14.45d	24.89c	10.01b
Cow 10 m^3		47.25ab	2.53bc	16.44cd	34.87b	14.59a
Cow 20 m^3		49.26ab	3.46ab	21.06bc	38.18b	15.20a
Compost 10 m^3		50.93a	3.84a	25.15ab	44.78ab	17.05a
Compost 20 m^3		53.27a	4.09a	27.68a	52.16a	18.34a
			Season 2015-16			
Control		43.80b	2.68c	17.13c	28.39b	15.04b
Cow 10 m^3		50.30ab	3.18bc	22.83bc	41.05ab	17.16ab
Cow 20 m^3		51.28ab	3.81ab	25.75b	45.55a	18.29ab
Compost 10 m^3		52.64a	4.25a	28.23ab	50.80a	20.07a
Compost 20 m^3		55.62a	4.39a	33.11a	55.82a	21.25a
Effect of the interaction between sowing dates and irrigation intervals						
Season 2014-15						
15th Oct.	Every day	52.28a	3.43a	31.27a	46.61a	18.87a
	Every two days	50.75ab	3.20a	24.61b	37.26ab	15.31ab
15th Nov.	Every day	47.62ab	3.15a	15.62c	39.77ab	13.39b
	Every two days	43.74b	2.88a	12.33d	32.26b	12.58b
			Season 2015-16			
15th Oct.	Every day	53.42a	4.06a	35.77a	52.11a	21.74a
	Every two days	52.64a	3.44bc	28.41b	41.36bc	19.16b
15th Nov.	Every day	50.24ab	3.98ab	18.61c	46.29ab	16.88c
	Every two days	45.23b	3.17c	18.86c	37.54c	15.67c
Effect of the interaction between sowing dates and fertilizers rates						
				Season 2014-15		
15th Oct.	Control	45.85cd	2.00c	19.51b	27.23de	10.94ef
	Cow 10 m^3	49.83a-c	2.65bc	21.85b	37.55cd	16.78a-c
	Cow 20 m^3	52.00a-c	3.77a	30.01a	42.11bc	18.17ab
	Compost 10 m^3	54.10ab	4.00a	33.83a	48.13ab	19.41a
	Compost 20 m^3	55.81a	4.17a	34.51a	54.65a	20.17a
15th Nov	Control	38.73d	1.83c	9.41d	22.55e	9.08f
	Cow 10 m^3	44.66cd	2.41bc	11.03cd	32.18c-e	12.41c-f
	Cow 20 m^3	46.53bc	3.15ab	12.13cd	34.25cd	12.23d-f
	Compost 10 m^3	47.76bc	3.68a	16.46bc	41.42bc	14.69b-e
	Compost 20 m^3	50.73a-c	4.01a	20.86b	49.67ab	16.51a-d
				Season 2015-16		
15th Oct.	Control	47.25bc	2.77c	21.27ef	31.84cd	16.57c-f
	Cow 10 m^3	52.67ab	3.16bc	29.00cd	43.25a-c	19.63a-d
	Cow 20 m^3	54.87ab	4.21ab	33.33bc	47.13a-c	20.77a-c
	Compost 10 m^3	55.14ab	4.33a	37.33ab	53.64ab	21.96ab
	Compost 20 m^3	58.71a	4.50a	39.51a	57.83a	23.33a
15th Nov	Control	40.10c	2.60c	13.00g	24.95d	13.50f
	Cow 10 m^3	45.82bc	3.20bc	16.66fg	38.86b-d	14.70ef
	Cow 20 m^3	48.95bc	3.63a-c	18.16fg	43.98a-c	15.82d-f
	Compost 10 m^3	48.94b	4.16ab	19.13fg	47.97a-c	18.19b-e
	Compost 20 m^3	52.46ab	4.28ab	26.73de	53.81ab	19.17a-d

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test. Control=100%NPK from recommended dose

Table 5. Effect of the interaction between irrigation intervals and organic fertilizers on plant height, number of branches, number of leaves, fresh and dry weight of pea plants during 2014-15 and 2015-16 seasons.

Characters / Variables		Plant height (cm)	No. Branches	No. Leaves	Plant fresh weight (g)	Plant dry weight (g)
Intervals	**Fertilizers**					
		90 Days from sowing				
		Season 2014-15				
	Control	44.16cd	2.08c	17.36de	32.63d	13.09b
	Cow 10 m3	47.73a-d	2.70bc	18.65c-e	36.91cd	15.30ab
Every day	Cow 20 m3	50.16a-c	3.46ab	22.41b-d	41.42b-d	15.86ab
	Compost 10 m3	52.70ab	4.11a	27.83ab	47.92ab	17.45ab
	Compost 20 m3	55.00a	4.12a	31.01a	57.06a	18.95a
	Control	40.42d	1.75c	11.53f	25.15e	12.93c
	Cow 10 m3	46.76b-d	2.36c	14.23ef	32.82d	13.89b
	Cow 20 m3	48.36a-c	3.45ab	19.73c-e	34.95d	14.54ab
Every two days	Compost 10 m3	49.16a-c	3.58ab	22.46b-d	41.63b-d	16.65ab
	Compost 20 m3	51.54a-c	4.06a	24.36bc	47.26a-c	17.73ab
		Season 2015-16				
	Control	46.81bc	3.08b-d	18.77de	39.30b	15.82cd
	Cow 10 m3	49.25a-c	3.75ab	24.00cd	43.11ab	17.69b-d
Every day	Cow 20 m3	52.63ab	4.08ab	27.50bc	50.63ab	19.30a-c
	Compost 10 m3	53.82ab	4.58a	30.30ab	54.66ab	21.13ab
	Compost 20 m3	56.17a	4.62a	35.40a	58.30a	22.61a
	Control	42.58c	2.29d	15.50e	26.49c	12.25c
	Cow 10 m3	48.27a-c	2.61cd	21.66cd	38.99b	16.63b-d
Every two days	Cow 20 m3	50.21a-c	3.55a-c	24.00cd	40.48b	17.28b-d
	Compost 10 m3	51.14ab	3.91ab	26.16bc	46.94ab	19.02a-c
	Compost 20 m3	53.61ab	4.17ab	30.83ab	53.34ab	19.89a-c

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range tests. Control=100%NPK from recommended dose

5. Effect of the interaction between sowing dates and organic fertilization rates

Data presented in Table 7 show significant effects of the interaction between the sowing dates and organic fertilization rates on yield and its components. In the first season, the planting of pea plants in the first sowing date (15th October) with compost at the rate of 20 m^3 per fed. recorded the highest values for all studied traits followed by the same date of sowing and with adding compost fertilization at the rate of 10 m^3 fed. or with adding of cow manure at the rate of 20 m^3 per fed. without significant differences between them for the number of seeds per pod, pod length, and yield per plant as well as yield per fed. in the second season, the number of pods per plant, number of seeds per pods, pod length and yield as well as yield per fed. gave the highest values with first sowing date and adding of compost fertilization by the rate of 20 m^3 per fed. followed by planting of pea plants at the second date with adding of compost fertilization by the rate of 20 m^3 per fed.

6. Effect of the interaction between irrigation intervals and organic fertilization rates.

Concerning the interaction between irrigation intervals and organic fertilization rates, the data in Table 8 reveal that the irrigation every day or every two days with adding compost fertilization at the rate of 20 m^3 per fed. recorded the highest values for increased number of pod per plant, number of seeds per pod, pod length, and yield per plant as well as yield per fed. in the both seasons followed by the irrigation every day with adding compost by the rate of 10 m^3 per fed. This is due to the ability of the highest compost rate to compensate relative to the lack of irrigation water. The increment of yield and its components may be owe to increase of added compost by the high rate of the 20 m^3 per fed. compared to adding 10 m^2 per fed. Whereas, the content of the macro and micro nutrients may increase besides the irrigation every day gave the optimizing growth and increased yield and its components of the pea. The correlation of irrigation and fertilization has been investigated by many researchers. Hirich *et al*. (2014) on *Pisum sativum*, found that the highest seed yield by addition of 10 t ha^1 (compost) with irrigation levels at 100% from full irrigation compared to application of 0 or 5 t ha^1 (compost) with irrigation levels at 50% from full irrigation. Also, (Sun *et al*., 2003; Ati *et al*., 2013) indicated that irrigation improves the efficiency of fertilization and there is a strong correlation between fertilizer utilization and the water supply of a plant

Table 6. Effect of the interaction among sowing dates, irrigation intervals and organic fertilizers on plant height, number of branches, number of leaves, fresh and dry weight of pea plants during 2014-15 and 2015-16 seasons.

Characters Variables			Plant height (cm)	No. Branches	No. Leaves	Plant fresh weight (g)	Plant dry weight (g)
Dates	Intervals	Fertilizers					
			90 Days from sowing				
			Season 2014-15				
		Control	49.00a-f	2.16d-f	24.66d	37.23c-h	14.63c-f
		Cow 10 m3	50.00a-f	2.83b-e	25.04cd	40.22c-g	17.79a-d
	Every day	Cow 20 m3	51.33a-e	3.83ab	32.33ab	47.05a-c	19.32a-c
		Compost 10 m3	54.87ab	4.16a	37.00a	51.11ab	20.76ab
		Compost 20 m3	56.20a	4.18a	37.33a	57.43a	21.87a
15th Oct.		Control	42.70fg	1.83ef	14.33e-g	17.23i	7.26g
		Cow 10 m3	49.66a-f	2.48c-f	18.66e	34.89d-h	15.77c-f
	Every two days	Cow 20 m3	52.66a-d	3.70ab	27.66b-d	37.18c-h	17.03b-e
		Compost 10 m3	53.33a-c	3.83ab	30.66bc	45.15b-d	18.07a-d
		Compost 20 m3	55.42ab	4.16a	31.66ab	51.88ab	18.46a-d
		Control	39.33g	2.10ef	10.06g	28.03h	11.55f
		Cow 10 m3	45.46c-g	2.58c-f	12.26f-g	33.61e-h	12.82ef
	Every day	Cow 20 m3	49.00a-f	3.10a-d	12.46f-g	35.79d-h	12.41ef
		Compost 10 m3	50.53a-f	4.03a	18.66e	44.74b-e	14.14d-f
		Compost 20 m3	53.81ab	4.05a	24.66d	56.71a	16.04c-f
15th Nov.		Control	38.13g	1.66f	8.73g	25.08i	11.60g
		Cow 10 m3	43.86e-g	2.24d-f	9.81f-g	30.76gh	12.01f
	Every two days	Cow 20 m3	44.06e-g	3.21a-d	11.81f-g	32.72f-h	12.05f
		Compost 10 m3	45.00d-g	3.34a-c	14.26e-g	38.11c-h	15.23c-f
		Compost 20 m3	47.66b-f	3.96a	17.06e-f	42.64b-f	16.99b-e
			Season 2015-15				
		Control	51.42a-f	3.18b-e	25.22d	44.64a-c	17.81c-h
		Cow 10 m3	53.62a-f	3.25a-d	31.66b-d	46.95a-c	20.40a-e
	Every day	Cow 20 m3	54.62a-f	4.56a-c	35.66b	52.64ab	22.43a-c
		Compost 10 m3	55.36a-d	4.51a	41.66a	55.58ab	23.19ab
		Compost 20 m3	57.88a	4.67a	44.66a	60.77a	24.87a
15th Oct.		Control	43.65f-h	2.37e	17.33ef	19.03de	15.34f-i
		Cow 10 m3	51.25a-f	2.52e	26.33d	39.54bc	18.85b-g
	Every two days	Cow 20 m3	53.67a-e	3.83a-d	31.00bd	41.63bc	19.10b-f
		Compost 10 m3	54.48a-d	4.16a-c	33.00bc	51.71a-c	20.73a-e
		Compost 20 m3	58.91a	4.34ab	34.33b	54.90ab	21.79a-d
		Control	41.52gh	3.21c-e	12.33f	33.96cd	13.84h-i
		Cow 10 m3	46.58c-h	3.66a-d	16.33ef	39.27bc	14.99f-i
	Every day	Cow 20 m3	50.47a-f	4.00a-c	19.33e	48.63a-c	16.17e-i
		Compost 10 m3	51.89a-f	4.66a	18.93e	53.75ab	19.07b-g
		Compost 20 m3	54.85a-c	4.57a	26.13d	55.83ab	20.34a-e
15th Nov.		Control	40.23h	2.20e	13.66ef	15.95e	13.17i
		Cow 10 m3	44.51f-h	2.73de	17.00ef	38.45bc	14.41g-i
	Every two days	Cow 20 m3	45.57e-h	3.26b-e	17.00ef	39.32bc	15.46f-i
		Compost 10 m3	46.31d-h	3.66a-d	19.33e	42.19bc	17.31d-i
		Compost 20 m3	48.95b-g	4.00a-c	27.33cd	51.79a-c	18.00c-h

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test. Control=100%NPK from recommended dose

7. Effect of the interaction among sowing dates, irrigation intervals and organic fertilization rates.

It is obvious that the data in Table 9 show that the interaction among sowing dates, irrigation intervals, and organic fertilization rates show significant differences in all studied traits in both seasons. The cultivation of pea plants in the first date (15th October) with the irrigation every day or every two days and adding compost fertilization at the rate of 20 m^3 per fed. recorded the highest values of number of pods per plant, number of seeds per pod, pod length, and yield per plant as well as yield per fed in both seasons, followed by treatment by planting of pea plants in the first date (15th October) with the irrigation every day with adding of compost fertilization at the rate of 10 m^3 per fed.

3. Photosynthetic pigments in leaves and contents of N, P, K, protein and carbohydrates in seeds:

1. Effect of sowing dates

Data present in Table 10 show significant effects for sowing dates on most chemicals constituents of pea plants, except chlorophyll a in second season and chlorophyll b in the both seasons, the first sowing date (15th October) recorded the highest values for chlorophyll a, b in leaves and contents of N, P, K, protein and carbohydrates in seeds of pea plants in both seasons.

Table 7. Effect of sowing dates, irrigation intervals and organic fertilizers on yield and its components of pea plants during 2014-15 and 2015-16 seasons.

Characters Variables		No. pod/plant	No. of seeds/pods	Pods length (cm)	Yield/plant (g)	Yield ton/fed.
Effect of sowing dates		First season 2014-15				
15th Oct.		9.20a	7.81a	11.43a	100.24a	4.21a
15th Nov.		7.51b	7.26b	10.71b	82.98b	3.48b
		Second season 2015-16				
15th Oct.		10.10a	8.10a	11.93a	111.18a	4.67a
15th Nov.		8.47b	7.61b	11.16b	92.18b	3.87b
Effect of irrigation intervals		Season 201415				
Every day		8.71a	7.76a	11.41a	97.00a	4.07a
Every two days		8.00b	7.30b	10.73b	86.22b	3.75b
		Season 2015-16				
Every day		9.69a	8.07a	11.76a	105.99a	4.45a
Every two days		8.88b	7.63b	11.33b	97.36b	4.09b
Effect of fertilizers rates		Season 2014-15				
Control		4.08c	6.51e	9.94b	43.13d	1.81d
Cow 10 m3		7.61b	7.33d	10.62ab	85.06c	3.57c
Cow 20 m3		9.08ab	7.83c	11.26ab	99.43b	4.17b
Compost 10 m3		9.72ab	7.91b	11.45ab	105.47b	4.43b
Compost 20 m3		11.28a	8.08a	12.07a	124.96a	5.24a
		Season 2015-16				
Control		4.93b	6.85d	10.54d	51.00e	2.14e
Cow 10 m3		8.58a	7.83c	11.12cd	98.14d	4.12d
Cow 20 m3		9.76a	8.08b	11.57bc	108.74c	4.56c
Compost 10 m3		10.74a	8.08b	11.97ab	115.60b	4.85b
Compost 20 m3		12.41a	8.41a	12.52a	134.91a	5.66a
Effect of the interaction between sowing dates and irrigation intervals						
Season 2014-15						
15th Oct.	Every day	9.87a	8.11a	11.71a	108.22a	4.54a
	Every two days	8.52b	7.61b	11.14ab	92.26b	3.87b
15th Nov.	Every day	7.54c	7.53ab	11.12ab	85.79c	3.60c
	Every two days	7.48c	7.00a-c	10.31b	80.18d	3.36d
		Season 2015-16				
15th Oct.	Every day	10.84a	8.33a	12.08a	116.06a	4.87a
	Every two days	9.36ab	7.86ab	11.78a	106.30b	4.46b
15th Nov.	Every day	8.54b	7.82ab	11.44ab	95.93c	4.03c
	Every two days	8.40b	7.41a-c	10.88b	88.43d	3.71d
Effect of the interaction between sowing dates and fertilizers rates						
		Season 2014-15				
15th Oct.	Control	4.67d	6.83b	10.08b	46.55e	1.95e
	Cow 10 m3	8.07bc	7.51a-e	11.28ab	92.93c	3.90c
	Cow 20 m3	9.77a-c	8.16a-b	11.53ab	107.11b	4.49b
	Compost 10 m3	11.15a	8.16a-b	11.83ab	115.65b	4.86b
	Compost 20 m3	12.33a	8.33a	12.41a	138.94a	5.83a
15th Nov.	Control	3.50d	6.16b	9.80b	39.71e	1.66e
	Cow 10 m3	7.16c	7.16b	9.96b	77.19d	3.24d
	Cow 20 m3	8.38bc	7.51a-e	11.00ab	91.75c	3.85c
	Compost 10 m3	8.29bc	7.66a-d	11.08ab	95.30c	4.00c
	Compost 20 m3	10.22ab	7.83a-c	11.73ab	110.98b	4.66b
		Season 2015-16				
15th Oct.	Control	5.71cd	7.33bc	10.91ef	55.68f	2.34f
	Cow 10 m3	9.20bc	7.83ab	11.48c-e	111.78c	4.69c
	Cow 20 m3	10.40ab	8.33ab	11.88b-d	119.53b	5.02b
	Compost 10 m3	11.93ab	8.33ab	12.48ab	122.18b	5.13b
	Compost 20 m3	13.27a	8.66a	12.91a	146.73a	6.16a
15th Nov.	Control	4.15d	6.38c	10.16f	46.32g	1.94g
	Cow 10 m3	7.97bc	7.83ab	10.77ef	84.50e	3.55e
	Cow 20 m3	9.12bc	7.83ab	11.26de	97.96d	4.11d
	Compost 10 m3	9.55a-c	7.83ab	11.46c-e	109.02c	4.58c
	Compost 20 m3	11.55ab	8.16ab	12.15a-c	123.09b	5.17b

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test.
Control=100%NPK from recommended dose

Table 8. Effect of the interaction between irrigation intervals and irrigation organic fertilizers on yield and its components of pea plants during 2014-15 and 2015-16 seasons.

Characters / Variables		No. pod/plant	No. of seeds/pods	Pods length(cm)	Yield/plant (g)	Yield ton/fed.
Intervals	Fertilizers					
			Season 2014-15			
	Control	4.19d	7.00ab	10.41ab	43.85e	1.84e
	Cow 10 m3	7.93bc	7.50ab	11.11ab	89.20cd	3.74cd
Every day	Cow 20 m3	9.65a-c	8.00ab	11.66a	106.34b	4.46b
	Compost 10 m3	9.89a-c	8.00ab	11.66a	108.39b	4.55b
	Compost 20 m3	11.87a	8.33a	12.21a	137.23a	5.76a
	Control	3.97d	6.00b	9.46b	42.41e	1.78e
	Cow 10 m3	7.29c	7.16ab	10.13ab	80.92d	3.40d
Every two days	Cow 20 m3	8.50bc	7.66ab	10.86ab	92.52c	3.88c
	Compost 10 m3	9.55a-c	7.83ab	11.25ab	102.56b	4.30b
	Compost 20 m3	10.68ab	7.83ab	11.93a	112.69b	4.73b
			Season 2015-16			
	Control	5.15cd	7.38ab	10.83c-e	52.41e	2.20e
	Cow 10 m3	8.86a-c	8.00a	11.58bc	97.36d	4.09d
Every day	Cow 20 m3	10.28ab	8.33a	11.73ab	111.17c	4.67c
	Compost 10 m3	11.21ab	8.33a	12.08ab	121.95b	5.12b
	Compost 20 m3	12.94a	8.33a	12.58a	147.10a	6.18a
	Control	4.71d	6.33b	10.25e	49.60e	2.08e
	Cow 10 m3	8.30b-d	7.66ab	10.67de	98.92d	4.15d
Every two days	Cow 20 m3	9.24ab	7.83ab	11.41b-d	106.32c	4.46c
	Compost 10 m3	10.27ab	7.83ab	11.86ab	109.26c	4.59c
	Compost 20 m3	11.87ab	8.51a	12.46a	122.72b	5.15b

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test. Control=100%NPK from recommended dose

2. Effect of irrigation intervals

It is clear from the data in Table 10 that there were significant differences of irrigation intervals on most chemical constituents, except chlorophyll a in the second season and chlorophyll b in both seasons. Addition of irrigation every day gave the highest values for chlorophyll a, b in leaves and contents of N, P, K, protein, and carbohydrates in seeds of pea plants in the both seasons. These results are in harmony with those reported by Embiale et. al. (2016) on *Pisum sativum* plant, who found that water-stress treatments (6, 9 and 12 days intervals) gave the lowest content of chlorophyll a, b and total chlorophyll compared to irrigation every 3 days interval to maintain the100% of field capacity.

3. Effect of organic fertilization rates

The data in Table 10 show significant effects of organic fertilization rates on most chemical constituents of pea plants, except chlorophyll a in both seasons, The highest values for chlorophyll a, b in leaves and contents of N, P, K, protein, and carbohydrates in seeds were recorded with the application of compost fertilizer at the rate of 20 m^3 in the both seasons followed by adding the rate of 10 m^3 from the same fertilizer. These results are in harmony with those reported by Khairy (2007) on pea plant, who found that chemicals constituents; i.e., nitrogen, phosphorus, potassium, total carbohydrates, and total protein in pea seeds were significantly increased with high rates from 15 and 30 m^3 fed^{-1}. of organic manure (FYM). Chinthapalli *et al*. (2015) found that the application of cow dung at 15 t ha^{-1} showed significant growth over the inorganic fertilizer urea and potassium chloride in terms of content of chlorophyll a, b and total sugar in both the legume plants as faba bean and pea plants.

4. Effect of the interaction between sowing dates and irrigation intervals

The data in Table 10 show significant effects duo to the interaction between sowing dates and irrigation intervals on all chemical constituents of pea plants in both seasons. Planting of pea in the first date (15th October) was better than from the second date (15th November) for the content of chlorophyll a, b in leaves and contents of N, P, K, protein, and carbohydrates in seeds of pea plants in the both seasons. The interaction between the early sowing date and irrigation every day had the superior effect on most chemical composition in leaves and seeds of pea plant this could reflect the effect of temperature and soil moisture on the elements absorption and transfer through root system from organ to organ in the plant. (Yilvaiaio and Pettovuori , 2012) observed that water-soluble phosphorus increased with soil temperature from 5 ^{0}C – 25 ^{0}C due to the increase in the movement of phosphorus in the soil controlled by diffusion.

5. Effect of the interaction between sowing dates and organic fertilization rates

The data in Table 10 show significant effects for the interaction treatments on most chemical constituents in the both seasons. The highest effect were due to the planting in the first date with adding compost fertilization at the rate of 20 m^3 per fed., followed by 10 m^3 per fed compost in the both seasons.

Table 9. Effect of the interaction among sowing dates, irrigation intervals and organic fertilizers on yield and its components of pea plants during 2014-15 and 2015-16 seasons.

Characters Variables			No. pod/plant	No. of seeds/pods	Pods length (cm)	Yield/plant (g)	Yield ton/fed.
Dates	Intervals	Fertilizers					
			Season 2014-15				
	Every day	Control	4.68fg	7.00ab	10.83a-e	45.20kl	1.90kl
		Cow 10 m3	9.29b-e	7.66a	11.56a-d	102.90de	4.32de
		Cow 20 m3	10.73bc	8.33a	11.83a-c	118.09b	4.96b
		Compost 10 m3	11.17ab	8.33a	11.83a-c	116.59b	4.91b
		Compost 20 m3	13.51a	8.66a	12.51a	158.32a	6.64a
15th Oct.	Every two days	Control	4.65fg	6.66ab	9.33de	47.91k	1.871k
		Cow 10 m3	6.86ef	7.33ab	11.00a-d	82.96h-j	3.48h-j
		Cow 20 m3	8.82b-e	8.00a	11.23a-d	96.14d-g	4.03d-g
		Compost 10 m3	11.14a-b	8.00a	11.83a-c	114.71bc	4.82bc
		Compost 20 m3	11.15ab	8.00a	12.33a	119.57b	5.02b
	Every day	Control	3.70g	7.00ab	10.00b-e	42.50kl	1.78kl
		Cow 10 m3	6.58ef	7.33ab	10.66a-e	75.50j	3.17j
		Cow 20 m3	8.58b-e	7.66a	11.51a-e	94.60e-g	3.97e-g
		Compost 10 m3	8.61b-e	7.66a	11.51a-e	100.19d-f	4.20d-f
		Compost 20 m3	10.23b-d	8.00a	11.93ab	116.14bc	4.88b
15th Nov.	Every two days	Control	3.29g	5.33b	9.62c-e	36.91l	1.55l
		Cow 10 m3	7.73de	7.00ab	9.26e	78.88ij	3.15ij
		Cow 20 m3	8.19c-e	7.33ab	10.52a-e	88.90g-i	3.73g-i
		Compost 10 m3	7.97c-e	7.66a	10.66a-e	90.41f-h	3.79f-h
		Compost 20 m3	10.21b-d	7.66a	11.53a-d	105.81cd	4.44cd
			Season 2015-16				
	Every day	Control	6.05de	7.66ab	11.16f-i	56.95i	2.39i
		Cow 10 m3	10.35a-c	8.00ab	11.83c-g	111.53f	4.68f
		Cow 20 m3	11.48a-c	8.66a	11.93b-f	123.71cd	5.19cd
		Compost 10 m3	12.07ab	8.66a	12.41a-d	123.71cd	5.19cd
		Compost 20 m3	14.26a	8.66a	13.06a	164.41a	6.90a
15th Oct.	Every two days	Control	5.38de	7.00b	10.66h-k	54.41i	2.28i
		Cow 10 m3	8.04b-e	7.66ab	11.13f-i	112.04f	4.56f
		Cow 20 m3	9.33b-d	8.00ab	11.83c-g	115.35ef	4.84ef
		Compost 10 m3	11.79ab	8.00ab	12.56a-c	120.66de	5.06de
		Compost 20 m3	12.27ab	8.66a	12.73ab	129.05bc	5.42bc
	Every day	Control	4.25e	7.10b	10.51i-k	47.85j	2.01j
		Cow 10 m3	7.38c-e	8.00ab	11.33e-i	83.19h	3.49h
		Cow 20 m3	9.09b-d	8.00ab	11.53d-h	98.63g	4.14g
		Compost 10 m3	10.35a-c	8.00ab	11.76c-g	120.18de	5.04de
		Compost 20 m3	11.63a-c	8.00ab	12.11d-e	129.79b	5.45b
15th Nov.	Every two days	Control	4.05e	5.66c	9.83k	44.80j	1.88j
		Cow 10 m3	8.56b-d	7.66ab	10.21jk	85.81h	3.49h
		Cow 20 m3	9.15b-d	7.66ab	11.11g-j	97.29g	4.09g
		Compost 10 m3	8.76b-d	7.66ab	11.16f-i	97.86g	4.11g
		Compost 20 m3	11.47a-c	8.33a	12.21b-e	116.39ef	4.88ef

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test. Control=100%NPK from recommended dose

Every day with application the rate of 20 m^3 from compost fertilizer followed by the same date and the rate of 10 m^3 from the same fertilization recorded the highest values of the content chlorophyll a, b in leaves and contents of N, P, K, protein, and carbohydrates in seeds of pea plants in the both seasons. The increase in the content of N, P, K, protein, and carbohydrates in seeds may be due to the high rate of compost and efficient of water which increased availability and movement of nutrients in plant cell and organs and direct effective for development of seed and productivity. Increasing the amount of water applied (irrigation every 4 days) with adding the high rate of organic manure for maize crop, resulted in a decline in moisture tension posed to plants, and the abundant water and increases the ability nutrients, which increases with increasing rates of organic fertilization Intsar *et al*. (2015).

The effect of increasing the content of nitrogen, phosphorus, potassium, chlorophyll, and carbohydrates is due to the optimum climatic conditions as observed in different climatic measurements which affect the microbial activity and degradation of organic matter, and the ability of elements for absorption which increased photosynthetic process in the plant, increased metabolic activities of micro-organisms as a result of increase in soil temperature will stimulate the availability of nutrients for plant. Soil temperature also affects nutrient uptake by changing soil water viscosity and root nutrient transport (Grossnickle, 2000; Lahti *et al.,* 2002).

6. Effect of the interaction between irrigation intervals and organic fertilization rates

The data in Table 11 show significant effects due to the interaction treatments in both seasons. The irrigation

Table 10. Effect of sowing dates, irrigation intervals and organic fertilizers on chlorophyll a, b in leaves and percent contents of N, P, K, Protein and carbohydrates in seeds of pea plants during 2014-15 and 2015-16 seasons.

Characters / Variables		Ch.a mg/gm F.w	Ch.b	N	P	K	Protein %	Carbohydrates
Effect of sowing dates				Season 2014-15				
15th Oct.		3.22a	2.80a	3.12a	0.486a	1.83a	19.53a	47.41a
15th Nov.		2.86b	2.37a	2.61b	0.326b	1.71b	16.32b	42.58b
						Season 2015-16		
15th Oct.		3.63a	2.96a	3.15a	0.500a	1.85a	19.71a	48.60a
15th Nov.		3.13a	2.51a	2.64b	0.350b	1.72b	16.53b	43.90b
Effect of irrigation intervals				Season 2014-15				
Every day		3.21a	2.67a	3.05a	0.427a	1.79a	19.09a	46.71a
Every two days		2.87b	2.51a	2.68b	0.385b	1.75a	16.75b	43.27b
				Season 2015-16				
Every day		3.56a	2.82a	3.08a	0.455a	1.81a	19.29a	47.84a
Every two days		3.21a	2.66a	2.71b	0.404a	1.76a	16.95b	44.69b
Effect of fertilizers rates				Season 2014-15				
Control		2.80a	2.38b	2.54c	0.358c	1.71d	15.88c	41.07d
Cow 10 m3		3.00a	2.51b	2.81b	0.383bc	1.74cd	17.60b	43.37c
Cow 20 m3		3.07a	2.59ab	2.92ab	0.398bc	1.77bc	18.25ab	45.29bc
Compost 10 m3		3.12a	2.61ab	3.01a	0.432ab	1.81ab	18.75a	47.17ab
Compost 20 m3		3.20a	2.85a	3.06a	0.459a	1.83a	19.14a	48.06a
				Season 2015- 16				
Control		3.16a	2.53b	2.56c	0.387c	1.72d	16.05c	42.42d
Cow 10 m3		3.36a	2.66b	2.84b	0.404bc	1.75cd	17.78b	44.16c
Cow 20 m3		3.39a	2.74ab	2.95ab	0.427a-c	1.78bc	18.47ab	46.65b
Compost 10 m3		3.45a	2.76ab	3.03a	0.453ab	1.81ab	18.95a	48.06b
Compost 20 m3		3.55a	3.00a	3.09a	0.477a	1.85a	19.36a	50.02a
Effect of the interaction between sowing dates and irrigation intervals								
				Season 2014-15				
15th Oct.	Every day	3.33a	2.98a	3.32a	0.525a	1.86a	20.78a	49.87a
	Every two days	3.10a	2.62b	2.92b	0.447b	1.79b	18.27b	44.94b
15th Nov.	Every day	3.09a	2.35c	2.78c	0.329c	1.71c	17.41b	43.56bc
	Every two days	2.63b	2.39c	2.43d	0.323c	1.70c	15.24c	41.60c
				Season 2015-16				
15th Oct.	Every day	3.79a	3.16a	3.36a	0.535a	1.89a	21.00a	51.02a
	Every two days	3.48ab	2.76b	2.94b	0.467b	1.80b	18.42b	46.19b
15th Nov.	Every day	3.32ab	2.47b	2.81b	0.374c	1.72c	17.58b	44.67bc
	Every two days	2.94b	2.55b	2.47c	0.341c	1.72c	15.48c	43.18c
Effect of the interaction between sowing dates and fertilizers rates								
				Season 2014-15				
15th Oct.	Control	2.95a-c	2.60ab	2.68d	0.423b	1.78cd	16.75d	43.08d
	Cow 10 m3	3.14a-c	2.77a	3.04c	0.451b	1.81bc	19.02c	45.82bc
	Cow 20 m3	3.25ab	2.84a	3.19bc	0.473b	1.82a-c	19.97bc	47.53b
	Compost 10 m3	3.34ab	2.87a	3.31ab	0.527a	1.84ab	20.69ab	49.60a
	Compost 20 m3	3.42a	2.94a	3.39a	0.555a	1.87a	21.21a	51.00a
15th Nov.	Control	2.66c	2.16c	2.40e	0.293d	1.63g	15.02e	39.05e
	Cow 10 m3	2.87bc	2.25c	2.59d	0.315cd	1.67fg	16.18d	40.93e
	Cow 20 m3	2.89bc	2.33bc	2.64d	0.323cd	1.71ef	16.54d	43.04d
	Compost 10 m3	2.91bc	2.35bc	2.69d	0.337cd	1.75de	16.81d	44.73cd
	Compost 20 m3	2.98a-c	2.77a	2.73d	0.363c	1.78cd	17.07d	45.13cd
				Season 2015-16				
15th Oct.	Control	3.32a-d	2.76ab	2.70d	0.448cd	1.80c-e	16.90d	45.01de
	Cow 10 m3	3.65a-c	2.92a	3.07c	0.468c	1.83b-d	19.21c	46.47cd
	Cow 20 m3	3.67a-c	3.00a	3.22bc	0.498bc	1.84bc	20.17bc	48.73b
	Compost 10 m3	3.72ab	3.03a	3.34ab	0.537ab	1.86ab	20.90ab	49.83b
	Compost 20 m3	3.82a	3.09a	3.42a	0.555a	1.91a	21.38a	52.98a
15th Nov.	Control	3.00d	2.30c	2.43e	0.325f	1.65h	15.21e	39.84g
	Cow 10 m3	3.07cd	2.39c	2.62d	0.340f	1.68gh	16.37d	41.86f
	Cow 20 m3	3.12b-d	2.48bc	2.68d	0.355ef	1.72fg	16.76d	44.58e
	Compost 10 m3	3.19b-d	2.49bc	2.72d	0.370ef	1.76ef	17.01d	46.30cd
	Compost 20 m3	3.28a-d	2.91a	2.77d	0.398de	1.78de	17.33d	47.05c

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test. Control=100%NPK from recommended dose

Table 11 . Effect of the interaction between irrigation intervals and organic manure on chlorophyll a, b in leaves and percent contents of N, P, K, Protein and carbohydrates in seeds of pea plants during 2014-15 and 2015-16 seasons.

Characters Variables		Ch.a	Ch.b	N	P	K	Protein	Carbohydrates
Intervals	Fertilizers	mg/gm F.w			(%)			
				Season 2014-15				
	Control	2.89a-c	2.44b-d	2.65ef	0.373cd	1.73d-f	16.57ef	42.67e
	Cow 10 m3	3.22ab	2.67a-c	3.01bc	0.402bc	1.76b-e	18.83bc	45.09cd
Every day	Cow 20 m3	3.25ab	2.70ab	3.16ab	0.422bc	1.79b-c	19.76ab	47.09bc
	Compost 10 m3	3.29ab	2.74ab	3.21a	0.455ab	1.81ab	20.00a	48.79ab
	Compost 20 m3	3.40a	2.79ab	3.25a	0.483a	1.85a	20.32a	49.93a
	Control	2.71c	2.32d	2.43g	0.343d	1.69f	15.21g	39.47f
	Cow 10 m3	2.78bc	2.34cd	2.62f	0.363cd	1.72ef	16.37f	41.66e
Every two days	Cow 20 m3	2.89a-c	2.47b-d	2.68ef	0.375cd	1.74c-f	16.75ef	43.48de
	Compost 10 m3	2.96a-c	2.48b-d	2.81de	0.408bc	1.78b-d	17.50de	45.55cd
	Compost 20 m3	3.00a-c	2.92a	2.87cd	0.435ab	1.80ab	17.96cd	46.21c
				Season 2015-16-				
	Control	3.28ab	2.59b-d	2.68ef	0.407c-e	1.75d-f	16.78ef	44.29d
	Cow 10 m3	3.53ab	2.82a-c	3.04bc	0.427b-d	1.78c-e	19.03bc	45.78cd
Every day	Cow 20 m3	3.58ab	2.85ab	3.20ab	0.455a-c	1.80b-d	20.01ab	48.39b
	Compost 10 m3	3.65ab	2.89ab	3.22a	0.482ab	1.84ab	20.15a	49.66ab
	Compost 20 m3	3.75a	2.94ab	3.28a	0.503a	1.88a	20.50a	51.09a
	Control	3.04b	2.47d	2.45g	0.367e	1.71f	15.33g	40.56f
	Cow 10 m3	3.19ab	2.49cd	2.64f	0.382de	1.73ef	16.54f	42.55e
Every two days	Cow 20 m3	3.20ab	2.63b-d	2.70ef	0.398c-e	1.76c-e	16.92ef	44.91cd
	Compost 10 m3	3.26ab	2.64b-d	2.84de	0.425b-d	1.79b-d	17.75de	46.47c
	Compost 20 m3	3.36ab	3.07a	2.91cd	0.451a-c	1.82bc	18.22cd	48.94b

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test. Control=100%NPK from recommended dose

7. Effect of the interaction among sowing dates, irrigation intervals and organic fertilization rates.

Data presented in Table 12 show significant effects due to the interaction among sowing dates, irrigation intervals and, organic fertilization rates of most chemical constituents, except content of N and its protein in both seasons and content of chlorophyll b in the second season The data in same table show that no significant effect between the interaction with irrigation every day and adding compost fertilization at the rate of 20 m^3 per fed., and between the planting pea plants in the second date with irrigation every two days and adding compost fertilization at the rate of 20 m^3 per fed. on content chlorophyll b in both seasons. In general, data show that the planting pea plants in the first date, irrigation every day with application of compost fertilization at the rate of 20 m^3 per fed or 10 m^3 from same fertilizer were the best treatments for increased chemical constituents; .i.e., content chlorophyll a, b in leaves and contents of N, P, K, protein, and carbohydrates in seeds of pea plants in the both seasons.

4. Plant water-relations

1.Effect of sowing date treatments on

1.Yield increasing and water saving

The data in Table 13 show that the higher total consumed water and total yield was at sowing date 15th Oct. but the lowest value was at sowing date 15th Nov. in the first and second seasons. These results led to reduce the total yield by (17.29% and 17.06%) and saved about (3.09% and 2.86%) of (IWR) in the 1st and 2nd seasons, respectively. From the present study, it is observed that the highest seed yield was obtained from plants grown at 15th Oct.

2. Water use efficiency (WUE)

Results in Table 13 showed a significant difference between two planting date for water use efficiency. The highest value of WUE was obtained with sowing date 15th Oct, while the lowest one was recorded with sowing date 15th Nov, during the two growing seasons.

2.Effect of irrigation treatments on

1.Yield reduction and water saving

Obviously deficit irrigation saves water but reduces the yield (Table 13). Irrigating of pea plants every two days during the different stages of growth reduced the total yield by (14.86 – 6.56% and 8.42 –7.80%) and saved about (41.97 – 47.93% and 43.17 – 43.56 %) of (IWR) at two sowing dates in the 1st and 2nd seasons, respectively. From the present study, it is observed that the highest yield was obtained from plants grown with no-stress (irrigation every day). Deficit irrigation tended to decrease the pea_yield. Irrigating of pea plants every two days during growing season led to a reduction of total seed yield in both seasons. In conclusion, deficit irrigation could be a suitable irrigation technique for pea production where the benefit from saving large amounts of water outweighs the decrease in total yield.

Table 12. Effect of the interaction among sowing dates, irrigation intervals and organic fertilizers chlorophyll a, b in leaves and percent contents of N, P, K , Protein and carbohydrates in seeds of pea plants during 2014-15 and 2015-16 seasons.

Characters / Variables			Ch.a	Ch.b	N	P	K	Protein	Carbohydrates
Dates	Intervals	Fertilizers	mg/gm F.w			(%)			
			Season 2014-15						
		Control	3.04a-g	2.67bc	2.82c	0.441cd	1.81cd	17.64c	44.76de
		Cow 10 m3	3.32a-c	2.98ab	3.22b	0.483bc	1.85bc	20.16b	47.68c
	Every day	Cow 20 m3	3.33a-c	3.02ab	3.47a	0.517b	1.86bc	21.71a	50.25b
		Compost 10 m3	3.41ab	3.08ab	3.52a	0.573a	1.88ab	22.00a	52.40a
15th		Compost 20 m3	3.55a	3.18a	3.58a	0.611a	1.92a	22.39a	54.26a
Oct.		Control	2.85c-g	2.54cd	2.53d	0.407d-f	1.75ef	15.85d	41.41hi
		Cow 10 m3	2.96b-g	2.55cd	2.86c	0.417de	1.78de	17.87c	43.95e-g
	Every two days	Cow 20 m3	3.17a-e	2.66bc	2.91c	0.431cd	1.78de	18.23c	44.81de
		Compost 10 m3	3.27a-c	2.67bc	3.11b	0.481bc	1.81cd	19.37b	46.81cd
		Compost 20 m3	3.28a-c	2.69bc	3.20b	0.500b	1.83b-d	20.03b	47.74c
		Control	2.74d-g	2.21d	2.48de	0.307hi	1.64h	15.50de	40.57hi
		Cow 10 m3	3.13a-f	2.36cd	2.81c	0.321ci	1.67gh	17.51c	42.50f-h
	Every day	Cow 20 m3	3.17a-e	2.39cd	2.85c	0.327c-i	1.72fg	17.81c	43.92e-g
		Compost 10 m3	3.17a-e	2.40cd	2.88c	0.337c-i	1.75ef	18.00c	45.18de
15th		Compost 20 m3	3.25a-d	2.40cd	2.92c	0.357f-h	1.78de	18.25c	45.60c-e
Nov.		Control	2.58g	2.11d	2.32e	0.281i	1.63h	14.54e	37.53j
		Cow 10 m3	2.61g	2.13d	2.38de	0.311g-i	1.67gh	14.87de	39.37ij
	Every two days	Cow 20 m3	2.62fg	2.28cd	2.44de	0.321g-i	1.71fg	15.27de	42.16gh
		Compost 10 m3	2.65fg	2.30cd	2.51de	0.337g-i	1.75ef	15.62de	44.29e-g
		Compost 20 m3	2.71e-g	3.14a	2.54d	0.371e-g	1.78de	15.89d	44.65d-f
			Season 2015-16						
		Control	3.44a-f	2.84b	2.85c	0.473c-e	1.84c-f	17.85c	47.49cd
		Cow 10 m3	3.83a-c	3.16a	3.25b	0.493b-d	1.88b-d	20.35b	48.48c
	Every day	Cow 20 m3	3.87ab	3.19a	3.52a	0.541a-b	1.89bc	22.02a	51.54b
		Compost 10 m3	3.87ab	3.25a	3.55a	0.583a	1.90b	22.23a	52.73b
15th		Compost 20 m3	3.95a	3.35a	3.61a	0.587a	1.97a	22.56a	54.86a
Oct.		Control	3.19d-f	2.68b-e	2.55de	0.423e-f	1.76h-j	15.96de	42.52ij
		Cow 10 m3	3.47a-f	2.69b-d	2.88c	0.443de	1.78g-i	18.04c	44.45f-h
	Every two days	Cow 20 m3	3.48a-f	2.81bc	2.93c	0.457de	1.80e-h	18.33c	45.92d-f
		Compost 10 m3	3.56a-e	2.81bc	3.13b	0.491b-d	1.83d-g	19.58b	46.94c-e
		Compost 20 m3	3.70a-d	2.84b	3.23b	0.523bc	1.85b-e	20.21b	51.11b
		Control	3.12d-f	2.34ef	2.51d-f	0.341gh	1.66lm	15.71d-f	41.09j-k
		Cow 10 m3	3.23c-f	2.49b-f	2.83c	0.361gh	1.68k-m	17.71c	43.08hi
	Every day	Cow 20 m3	3.30b-f	2.51b-f	2.88c	0.371fg	1.71j-l	18.00c	45.25e-g
		Compost 10 m3	3.43a-f	2.52b-f	2.89c	0.381fg	1.78g-i	18.08c	46.59de
15th		Compost 20 m3	3.55a-e	2.52b-f	2.95c	0.420ef	1.78f-i	18.44c	47.33cd
Nov.		Control	2.89f	2.27f	2.35f	0.311h	1.64m	14.71f	38.59l
		Cow 10 m3	2.92f	2.29f	2.40ef	0.321gh	1.68k-m	15.04ef	40.65k
	Every two days	Cow 20 m3	2.93ef	2.45d-f	2.48d-f	0.340gh	1.73i-k	15.52d-f	43.90g-i
		Compost 10 m3	2.96ef	2.46c-f	2.54de	0.360gh	1.75h-j	15.91de	46.01d-f
		Compost 20 m3	3.02ef	3.31a	2.59d	0.377fg	1.79f-h	16.23d	46.77c-e

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test. Control=100%NPK from recommended dose

2. Water Use Efficiency (WUE)

The water use efficiency for fully and deficit irrigation treatments are presented in Table 13. Increasing the irrigation deficit gained a high increase in the WUE. The highest value of WUE was obtained with irrigation every two days treatment, while the lowest one was recorded with irrigation every day treatment. The difference in WUE between irrigation every day and irrigation every two days was high; however, these differences were significant during the two tested seasons.

A sharp increase in WUE was obtained by deficit irrigation. This indicates that water movement into seeds may be decreased with the progressive in water deficit without effect on the translocation of dry matter into the seed and this effect resulted in an increase in mass production per unit of water, which in turn increase water use efficiency.

3. Effect of organic fertilizers on

1.Yield reduction and water saving

Increasing all investigated organic fertilizers rates led to increasing of water saving (Table 13). Also the yield of pea was increased by increasing the rate of organic fertilization. The highest value of increasing pea yield was found with 20 m^3 of compost fertilizers compared with other treatments. While, the results showed that the addition of 10 m^3 of cow manure gave the lowest value of water saving and decrease the percentage of increasing in yield in the both seasons compared to the control treatment. These results may be due to increasing the ability organic matter to catching the water.

Table 13. Effect of the interaction among sowing date, irrigation intervals and organic fertilizers on total consumed water, yield, water saving, increasing in yield, and water use efficiency of pea during 2014-15 and 2015-16 seasons.

Treatments			Total consumed water (m3 fed.$^{-1}$)	Yield (kg fed.$^{-1}$)	Water saving (%)	increasing in yield (%)	Water use efficiency (kg m^{-3})	Total consumed water (m3 fed.$^{-1}$)	Yield (kg fed.$^{-1}$)	Water saving (%)	increasing in yield (%)	Water use efficiency (kg m^{-3})
Sowing date	Irrigation intervals	Organic fertilizer	Season 2014-15					Season 2015-16				
		Control	1805.42	1900	0.00	0.00	1.05	1801.24	2390	0.00	0.00	1.33
		Cow 10 m^3	1781.12	4320	1.35	56.02	2.43	1761.02	4680	2.23	48.93	2.66
		Cow 20 m^3	1701.21	4910	5.77	61.30	2.89	1698.31	5190	5.71	53.95	3.06
	Every day	Compost 10 m^3	1625.21	4970	9.98	61.77	3.06	1602.11	5190	11.06	53.95	3.24
		Compost 20 m^3	1562.23	6640	13.47	71.39	4.25	1531.03	6900	15.00	65.36	4.51
	Mean		1695.04	4548	-	-	2.68	1678.74	4870	-	-	2.90
15th Oct.		Control	1120.21	2010	0.00	0.00	1.79	1098.14	2280	0.00	0.00	2.08
		Cow 10 m^3	1099.25	3480	1.87	42.24	3.17	998.08	4700	9.11	51.49	4.71
		Cow 20 m^3	957.02	4030	14.57	50.12	4.21	929.06	4840	15.40	52.89	5.21
	Every two days	Compost 10 m^3	899.54	4820	19.70	58.30	5.36	897.51	5060	18.27	54.94	5.64
		Compost 20 m^3	842.04	5020	24.83	59.96	5.96	847.21	5420	22.85	57.93	6.40
	Mean		983.61	3872	-	-	3.94	954.00	4460	-	-	4.68
Mean			1339.33	4210	-	-	3.14	1316.37	4665	-	-	3.54
		Control	1815.42	1780	0.00	0.00	0.98	1791.24	2010	0.00	0.00	1.12
		Cow 10 m^3	1791.12	3170	1.34	43.85	1.77	1681.02	3490	6.15	42.41	2.08
		Cow 20 m^3	1721.21	3970	5.19	55.16	2.31	1608.31	4140	10.21	51.45	2.57
	Every day	Compost 10 m^3	1665.21	4200	8.27	57.62	2.52	1592.11	5040	11.12	60.12	3.17
		Compost 20 m^3	1542.23	4880	15.05	63.52	3.16	1501.03	5450	16.20	63.12	3.63
	Mean		1707.04	3600	-	-	2.11	1634.74	4026	-	-	2.46
15th Nov.		Control	1020.21	1550	0.00	0.00	1.52	1018.14	1880	0.00	0.00	1.85
		Cow 10 m^3	902.41	3310	11.55	53.17	3.67	989.06	3600	2.86	47.78	3.64
		Cow 20 m^3	887.52	3730	13.01	58.45	4.20	941.50	4090	7.53	54.03	4.34
	Every two days	Compost 10 m^3	835.42	3790	18.11	59.10	4.54	875.10	4110	14.05	54.26	4.70
		Compost 20 m^3	798.60	4440	21.72	65.09	5.56	789.08	4880	22.50	61.48	6.18
	Mean		888.83	3364	-	-	3.78	922.58	3712	-	-	4.02
	Mean		1297.94	3482	-	-	2.68	1278.66	3869	-	-	3.03

Control=100%NPK from recommended dose

2.Water Use Efficiency (WUE)

In all cases, doubled amount of all organic fertilizers increased the WUE of both well and stressed water plants (Table 13). The highest value was obtained with application of doubled amount compost under irrigation every two days treatment during the first and second seasons. The lowest value of WUE was obtained with without application of organic fertilizer i.e. added recommended NPK dose (control) under irrigation every day treatment during two growing seasons.

4. Effect of the interaction between sowing date, irrigation intervals and organic fertilizers

1.Yield reduction and water saving

Increasing all investigated organic fertilizers rates with lowering the irrigation water amount led to water saving more than 24% (Table 13). Although, seed yield of pea plant increase by more than 71% under irrigation every day with adding 20 m^3 of compost fertilizers and sowing date in 15th Oct., but irrigation every day treatment with recommend NPK dose fertilized (control) and sowing date in 15 th Oct. gave the lowest value of reduction in yield during the first season.

2. Water Use Efficiency (WUE)

In all cases, doubled amount of all organic fertilizers increased the WUE of both well and stressed water irrigation (Table 13). The highest value of WUE (5.96 and 6.40 kg m^{-3}) was obtained with application of doubled amount compost under irrigation every two days treatment in the first and second seasons, respectively. The lowest value of WUE (0.98 and 1.12 kg m^{-3}) was obtained from without application of organic fertilizer (100 % NPK from recommended dose) under irrigation every day treatment in the first and second seasons, respectively. Values of WUE increased as water deficit and with application of organic fertilizers especially compost this may be due to water movement into seeds without effect on the translocation of dry matter into the seed and this effect resulted in an increase in mass production per unit of water Shouse *et al*. (1981). Although drought-tolerant species maintain water-use efficiency by reducing the water loss, longevity of drought period reduced it Anjum *et al*. (2009).

CONCLUSION

According to the obtained results, it can be said that, the superior treatments for produce high green yield and its components of pea plants, it recommend that the cultivation of pea plants in the first date (15th October) with distribution of the water ration of pea (2100 m^3/fed.) for irrigation every or half for irrigation every two days and adding compost fertilization at the rate of 20 m^3 per fed. Followed by pea planting of 15th October with the irrigation every day with adding of compost fertilization at the rate of 10 m^3 per fed. Regarding the water relations resulted in indicated that, irrigating of pea plants every two days during the different stages of growth reduced the total yield by 17.29 % and 17.06 % and water saving about 3.09 % and 2.86 % in two growing seasons respectively. In addition, increasing all investigated organic fertilizers rates with lowering the irrigation water amount led to water saving more than 24 %. However, the highest value of water use efficiency (5.96 and 6.40 kg m^{-3}) in the first and second season respectively was obtained with application of doubled amount compost (20 m^3 per fed.) with irrigation every two days treatment under sandy soil condition in North Sinai location.

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تاثير مواعيد الزراعه وفترات الرى والتسميد العضوى على نمو وانتاجية نباتات البسله تحت ظروف الاراضى الرمليه

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أجريت تجربتين حقليتين خلال الموسمين الشتويين 2014-15 و 2015-16 بمحطة البحوث الزراعية بالعريش- شمال سيناء- قسم بحوث الخضر - معهد بحوث البساتين- مركز البحوث الزراعية – مصر . وكان الهدف من التجربة هو دراسة تأثير ميعادين للزراعة (15 اكتوبر و 15 نوفمبر) ومعاملتين للرى (100% من الاحتياجات المائية للبسلة وهى 2100 م3 خلال موسم النمو موزعة للرى كل يوم و نصف الاحتياجات موزعة للرى كل يومين) وخمسة معاملات تسميد هى : 100 % من التوصية السمادية من النتروجين والفوسفور والبوتاسيوم ومعدلين من كل من سماد المواشى وسماد الدواجن هما 10و 20 م^3 / فدان على نمو ومحصول صنف البسلة سيمنتى . إستخدم تصميم القطاعات الكامله العشوائيه ونظام القطع المنشقه مرتين فى ثلاث مكررات ، حيث وزعت مواعيد الزراعه عشوائيا فى القطع الرئيسيه ، ووزعت فترات الرى عشوائيا فى القطع تحت الرئيسيه، ووزعت معاملات التسميد عشوائيا فى القطع تحت تحت الرئيسيه. اظهرت النتائج ان القيم الاعلى لقياسات النمو اى إرتفاع النبات و عدد الافرع و عدد الاوراق، والوزن الطازج والجاف لنباتات البسله سجلت لميعاد الزراعة الاول (15 اكتوبر) مع الرى يوميا والتسميد بالكومبوست بمعدل 20 أو 10 م^3/ فدان تليها الزراعه فى نفس الميعاد والرى كل يومين مع إضافة الكومبوست بمعدل 20 م^3/الفدان . اما بالنسبة للمحصول ومكوناته، فقد بينت النتائج ان الميعاد الاول للزراعة (15 اكتوبر) مع الرى كل يوم أو كل يومين والتسميد بـــــمعدل 20 م^3/ فدان حيث أعطت أعلى القيم معنويا لعدد القرون / نبات وعدد البذور فى القرن الواحد وطول القرن ووزن قرون / نبات وكذلك المحصول الكلى للفدان , تليها الزراعة فى نفس الميعاد (15 اكتوبر) مع الرى كل يوم والتسميد بالكومبوست بمعدل 10 م^3/الفدان. وكذلك اظهرت النتائج ان القيم الاعلى لمحتوى الاوراق من صبغات التمثيل الضوئى اى كلوروفيل أ , ب وكذلك محتوى البذور من النتروجين والفوسفور و البوتاسيوم و والبروتين والكربوهيدرات تم الحصول عليها بالزراعة فى 15 اكتوبر والرى كل يوم مع اضافة سماد الكمبوست بمعدل 20 او 10 م3 / فدان يليها الزراعة فى نفس التاريخ مع الرى كل يومين و اضافة 20 م3 / فدان من الكمبوست . وفيما يتعلق بالعلاقات المائيه فقد أوضحت الدراسة أن نباتات البسله التى تروى كل يومين خلال مراحل النمو المختلفة قد انخفض المحصول الكلى لها بنسبة 17.29٪ و 17.06٪ ولكن وفرت مياه رى حوالي 3.09٪ و 2.86٪ في موسمي النمو على التوالي . بالإضافة إلى ذلك، ادت الزيادة فى معدلات الاسمدة العضوية المدروسة مع خفض كمية مياه الري الى توفيرفى المياه بأكثر من 24٪. و من هذه النتائج اتضح ان اعلى قيم لكفاءة استخدام المياه وهى 5.96 و 6.40 كجم / م$^{-3}$ في الموسمين الأول والثاني على التوالي و ذلك باضافة المعدلات المضاعفه من التسميد العضوى بالكمبوست 20 م ^{3} للفدان مع الرى كل يومين تحت ظروف التربة الرملية في شمال سيناء.