Effect Of Irrigation Frequency by Applying Several Levels of Nitrogen Fertilization on the Anise Crop (*Pimpinella Anisum*) (Quantitative and Qualitative)

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Abstract:
In order to evaluate the effect of irrigation frequency and nitrogen fertilization on the percentage of anise seed oil and crop yield, The experiment was conducted at Taiba Research Station of the Research Center in Damascus Countryside during two seasons 2015 and 2016. The effect of two factors was studied: irrigation frequency (10, 14, 18) days according to the field capacity, and the nitrogen fertilization rate (0, 30, 40) kg/ha, (green up) 43% N2. Anise was used at seed rate (20.5) kg/ha, the results showed a clear effect For irrigation frequency over productivity, with a significant superiority in treatment (10) days of irrigation frequency, in which the highest productivity was (168.81) kg/ha, the differences were statistically significant for (14) days of irrigation frequency, with (30) kg/ha fertilizers, the most productive of anise, as well as (14) days of irrigation frequency rate is the best in oil percentage (3.64%) without the effect of nitrogen fertilization.

Key words: Anise - frequency of irrigation - nitrogen fertilization - rate of anise seed oil

Introduction

Anis (*Pimpinella anisum* L), is an annual herbaceous plant of umbel family (Apiaceae), native to middle east (Hemphill and Hemphill, 1988), and is known by several names as Yankon or Cumin, and in Morocco named the sweet green, India, Mexico, Egypt, Italy, Spain, Syria, France, Bulgaria, and Tunisia, are the most important producers' countries (Reineccius, 1994). the ancient Egyptians were the first to plant anise, and then the Romans (Dwyer and Rattray,1997), it was used in popular medicine as stimulant, diuretic, carminative, sedative, galactagogue, expectorant, and antispasmodic, (Arslan, 2004). Aniseeds contains of essential oil to have the medicine effectiveness as antioxidant, bactericidal, digestive, (Lawless, 1999).

Anise (*Pimpinella anisum* L) is used for the treatment of a carminative, antiseptic, antispasmodic, expectorant, stimulant, and stomachic. In addition, it has been used to promote lactation in nursing mothers and as a medicine against bronchitis and indigestion. Muller-Schwarze, (2006). The role of nitrogen in plant nutrition has been studied extensively during the past century and still continuing until today. A great number of researches were carried out on medicinal plants to determine their requirements and their response to ammonium sulphate and ammonium nitrate as well as the balance between these two forms. Many reports demonstrated that low N levels caused a reduction on growth and some chemical constituents (Kreydiyyeh *et al.*, 2003).

Amino acids are essential for plant growth as they are involved in the biosynthesis plant compound. Tryptophan is the main precursor of the natural plant auxin (indole acetic acid) consequently; its application may affect growth, yield and the chemical constituents of the plant, Abou Dahab and Nahed (2006). And the essential structure component; is the anithol. the yield growth of anise effect by several genetic, agriculture, and environment factories. The agriculture time have effect on yield seeds and oil (Askari *et al*. 1998). The irrigation is the most important influencing factors on the growth and active (Randhawa *et al*, 1992). Inadequate irrigation during germination and flowering and lengthening of the stem affects significantly, to affect a large decrease of rate and aniseeds productivity (Omidbaigi and Hornok, 1992), otherwise an increase of seeds productivity to be an irrigation suitable result, without to affect the oil rate.

In Study of (Milica *et al*., 2013**)** showed that in application of six different fertilizer regimes to determining the content and composition of the aniseed essential oil. It was found that the average essential oil content of aniseed, obtained by hydro distillation, was 3.72%. The weather conditions during the year and the locality had a statistically significant effect on the essential oil content, while different source of fertilizers was not statistically significant for the essential oil content and its composition.

The content and the composition of essential oils of aniseed are affected by ecological conditions, growing techniques and fruit maturity level (Özel, 2009). The investigation of the composition of essential oil from anise fruits cultivated in different countries show that some significant differences in concentration of some compounds in oil are present (Orav *et al*., 2008). But in different countries, apart from different climatic and soil characteristics, different ecotypes are cultivated, so differences in essential oil content and composition are huge.

Water deficit can affect all growth parameters and yield attributes severely, with the exception of the number of branches per caraway plant. Moreover, the seed yield and its components significantly decreased under moderate and severe water deficit (Laribi *et al*., 2009). Application of three irrigations at the branching, flowering and seed formation stages produced a significantly greater seed yield than all the other moisture regimes except for omitting irrigation at the seed formation stage. In addition, the water use efficiency was the highest when irrigation was omitted at the seed formation stage followed by the application of three irrigations at branching, flowering and seed formation (Kumar *et al*., 2008). Otherwise, the lower WUE was associated with a higher amount of irrigation water (Kamkar *et al*., 2011).

On the other hand, Mohamed (2000) studied Carum carvi L. plants and found that both essential oil percentage and oil yield were increased with decreasing the irrigation intervals. Increasing irrigation level from 70% potential evapotranspiration (ETP) to 110% (ETP) significantly increased the essential oil yield of C. sativum L. plant (Osman and El-Fiky, 2005). Nevertheless, the maximum volatile oil yield of coriander was obtained when the lowest irrigation rate was applied compared to the highest irrigation rate (Osman, 2000). Irrigation water also affected not only the volatile oil percentage but also oil composition of coriander fruits (Hassan *et al*., 2012). Limited water supply is an important factor affecting growth and metabolic activities of plant species. It has a generally negative effect on plant growth and development. However, there are reports on the positive effect of limited water supply, as far as the biosynthesis of secondary metabolites, enzyme activities and solute accumulation are concerned (Sangwan *et al*., 2001).

Increasing the irrigation intervals increased the volatile oil percentage; however, the volatile oil yield was in an opposite manner (Afify *et al*., 1993; Eid *et al*., 1995; Hammam, 1996)

A study (Nabizadeh *et al*., 2012) showed at 3 levels (0, 60 and 120 kg/ha) of Nitroxin at 3 levels of (0, 3, 6 l/ha) with three plant densities (with fixed rows). 30 cm, with plants in row spacing 2, 4, 8 cm is equivalent to 50, 25 and 12.5 plants/m^2

The highest yield of seeds and oil was achieved by 3 l/ha Nitroxin and 60 kg/ha with density of 25 plants/m^2 respectively.

Hassan und Ali (2014) have studied the effect of five irrigation levels applied by drip irrigation system on growth yield and chemical composition of coriander plants and found that the vegetative growth parameters were improved as a result of applying higher irrigation levels compared to lower levels. Irrigation water use efficiency (IWUE) was increased by reducing the irrigation levels.

Irrigation as an environmental factor has an important role in plant growth and is essential to increase yield and quality of plants (Singh and Goswamy, 2000). Deficit irrigation, one of the environmental stresses, is the most significant factor restricting plant growth and crop productivity in the majority of agricultural fields of the world (Abedi and Pakniyat, 2010). Identifying growth stages of a particular cultivar under local conditions of climate and soil fertility allows irrigation scheduling to maximize crop yield and most efficient use of scarce water resources (Singh and Goswamy, 2000). One of the environmental factors that restrict plant growth and agricultural crop productivity is the lack of irrigation water availability (Abedi and Pakniyat, 2010). Which involves scheduling the addition of irrigation water according to the stages of growth of the cultivated variety in order to obtain high productivity and more efficient use of scarce water resources (Singh and Goswamy, 2000).

The results from a study on anise (*Pimpinella anisum* L) in Turkey showed that plant height, number of branches per plant, number of umbellets per plant, number of seeds per umbellet, seed yield and thousand seed weight were affected positively by organic fertilizer and organic–inorganic fertilizer combination application (Doğramaci and Arabaci, 2010). (Nabizadeh *et al*.,2012) reported that the highest seed yield and the highest oil content were achieved (1,286 and 179 kg/ha) by fertilizer treatment using biological Nitroxin (3 l/ha) and chemical nitrogen (60 kg / ha) with the density of 25 plants/m^2 respectively.

The irrigation is the most important influencing factors on the growth and active (Randhawa *et al*, 1992). Inadequate irrigation during germination and flowering and lengthening of the stem affects significantly, to affect a large decrease of rate and aniseeds productivity (Omidbaigi and Hornok, 1992), otherwise an increase of seeds productivity to be an irrigation suitable result, without to affect the oil rate.

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The objective of research

1- Determinate the suitable irrigation frequency with nitrogen fertilization rates, which has the best probable aniseeds productivity.

2- Determine the effect of irrigation frequency and nitrogen fertilization rates on oil rate.

materials and methods:

plant material:

Anise seeds (Pimpinella anisum L) local cultivar specie in region were used, one of the genotypes cultivated in Syria, and the seed yield varies between (146.34- 382.32) Kg/ha (Al-Ahmad .H *et al*.,2014)

Site description:

the research was carried out in AL Taybba Research Station; belongs to General Commission for Scientific Agricultural Research\ Damascus Countryside Center; during 2016-2017 harvest season, 25 Km south far from the city, at an altitude of 850 m above the sea level with coordinates of (33°20'23.9"N, 36°04'45.5"E), it is characterized by a semiarid

Mediterranean climate and classified in the agricultural stability zone [4], with an annual rainfall (210 mm annually) winters and hot-dry summers. Temperatures ranged from 4.2˚C to 38.5 ˚C with moderate relative humidity of 58%. Soil was moderately fertile with clay loam and gravel texture and pH of 7.82 (FAO, 2004).

Table1. physicochemical properties of soil

Bulk density	1.1
Clay %	38
Silt %	26
Sand %	36
pH	7.82
dS/m	0.88
Ca_2CO_3	33.5
Organic Matter %	1.201
N total %	8
Available Phosphorus (mg kg $^{-1}$)	200
Exchangeable potassium (mg kg $^{-1}$)	5

Table2. Climatic data of the research site (2016/2017)

Months	Maximum Temperature (0C)	Minimum Temperature (0C)	Relative Humidity Average (%)
Feb	16.00	7.20	61.88
March	19.65	9,85	52.00
April	23.00	13.64	44.83
May	31.28	16.73	39.29
June	34.92	17.29	37.71

the studied factors:

The study included two factors, the first was the frequency of irrigation (10,14,18) days, and the second factor was the nitrogen fertilization rate (0,30,40) kg/ha, (green up) %43 N2.

Oil extraction: seeds were hand harvested every year in September from three plants per treatment plot. Seeds were air dried, cleaned, weighed and analyzed for oil content in the laboratory of the Research Centre using Soxhlet extractor. For each run, 30 g of crushed anise seeds was charged into the Soxhlet extractor and 150 ml of petroleum meter was used. Leaching was carried out until a clear liquid was obtained from the anise, which indicated complete leaching of the leachable oil. The extracted phase (oil and solvent) was then distilled in two stages to separate the oil and solvent. The first stage was a simple distillation followed by a second stage, which was a Rotate pour apparatus. A vacuum pump was attached to the Rotate pour apparatus to ensure complete removal of the solvent (Abu-Arabi *et al*., 2000).

the method of cultivation:

Agricultural operations: The land was prepared for cultivation by conducting two orthogonal tillers in order to soften the soil and get rid of weeds in the field. Anise seeds were planted at a rate of (20.5) kg/ha on (15/3) for the two seasons, and the area of the experimental plot was (4) m^2. irrigation was carried as deferent frequencies according to specific time, as for the nitrogen fertilization, it was carried out in two stages, the first after full germination and the second after the first grassing. Grassing was maid tow times manual after take the grass

density numbers. the date of weaning irrigation was in 12-15/6, Then harvesting was carried out manual after 15 days from weaning.

The experiment contains two main factors, irrigation frequency (10 day) 3916.8 irrigation m^3/ha ,(14 day) 5172.7 irrigation m^3/ha ,(18 day) 6514.13 irrigation m^3/ha, and fertilization rate of nitrogen (0, 30, 40) Kg\ ha, (green up) 43% N2. and as a sign to ripeness the change the seeds colure to olive green, after that were recorded the productivity to each treatment based on Kg\ ha seeds weight, Random samples were then taken at a rate of 900 g of each treatment to estimate their aromatic content, in a thermal distillation method, in the general commotion scientific research laboratories.

the studied characteristics:

1 .The productivity readings were recorded for each treatment on the basis of kg/ha of seed weight.

2 . Random samples of seeds were taken at a rate of (900) g from each treatment to estimate the content of essential oils by thermal distillation method in the laboratories of the General Authority for Scientific Agricultural Research.

the design of the experiment and statistical analysis:

The experiment was designed according to the design of the split plots of the first class, with three replications, where the main pieces were occupied (the first factor), which is the frequency of irrigation, and the split plots were of the first degree (the second factor), which was the rates of nitrogen fertilizer. The number of experimental pieces w**as 3*3*3=27, Space of the pilot piece= 4 m^2. the main factor** about irrigation frequency (10, 14, 18) day, requirement, were arranged in main plots, **the second factor** fertilization rates of nitrogen (0, 30, 40) Kg/ha, (green up) 43% N_2, were employed in sub plots.

Results and discussion:

1. The effect of irrigation frequency and fertilization in aniseeds productivity:

Statistical analysis of the experiment data in Table No (3) shows a clear effect of irrigation frequency on the yield of the crop from seeds in general with a significant superiority of treatment (10) days in irrigation frequency, which achieved the highest productivity of seeds, which amounted to (168.81) kg/ha compared to with other transactions. The differences were also significant among all treatments in general in terms of productivity. This is consistent with the results of a study (Laribi et al., 2009, Kumar et al., 2008) due to the positive effect of limited water supply, regarding secondary metabolite biosynthesis, enzyme activities and solute accumulation (Sangwan et al., 2001).

Based on the above, treatment (14) days of irrigation frequency with fertilization rate of (30) kg/ha (Greenup 43%) can be considered the most efficient in terms of the productivity of the anise crop from seeds. Drought stress can change plant behavior regarding the biosynthesis of primary and secondary metabolites.

Table 3. Effect of irrigation intervals on the mean productivity of seeds and the mean oil seed content %

irrigation intervals (Days)	yield (kg/ha)		oils seed %	
Irri.1 = 10 Kg/ha	168,81	a	2,98	b
Irri.2= 14 Kg/ha	135,57	b	3,64	a
Irri.3= 18 Kg/ha	64,39	c	2,97	bc
rep.	9		9	
d.f.	16		16	
l.s.d.	7,72		0,3146	

The differences are statistically significant for (14) days of irrigation frequency, with (30) kg/ha of fertilizer.

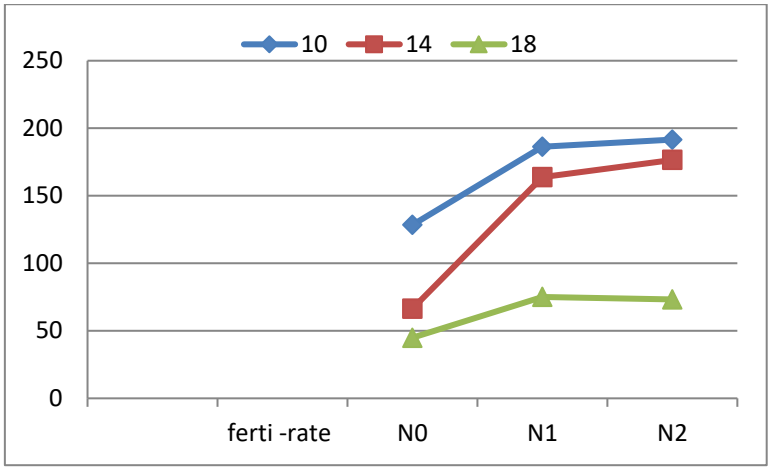

Fig.1. The effect of irrigation frequency and fertilization in aniseeds productivity

2. Effect of irrigation frequency and fertilization on aniseeds oil:

Deficient irrigation can alter plant behavior with respect to the biosynthesis of primary and secondary metabolites. On the other hand, the nitrogen fertilization achieved a significant increase in the yield of the crop. The two fertilization treatments (30 kg/ha) and (40 kg/ha) were significantly different from the non-fertilized control in terms of seed production, while the differences were apparent between them, and this is consistent with the study of (Nabizadeh et al., 2012). In terms of oil content, the nitrogen fertilizer level 40 Kg/ha decreased oil content significantly compared to the control N0, whereas the effect of fertilization level 30 kg/ha was not significant compared to the control N0.

It is also consistent with the study (Doğramaci and Arabaci, 2010). (Nabizadeh et al., 2012) and the use of a mixture of organic and inorganic fertilizers where the highest seed production of aniseed and the highest oil content were also achieved.

Based on the above, treatment (14) days of irrigation frequency with fertilization rate of (30) kg/ha (Greenup 43%) can be considered the most efficient in terms of the productivity of the anise crop from seeds. Drought stress can change plant behaviour regarding the biosynthesis of primary and secondary metabolites.

The nonsignificant differences between the control and the fertilization treatments 30 kg/ha, means that effect of nitrogen fertilization on the oil content of seeds is not significantly important. This is inconsistent with the study (Doğramaci and Arabaci., 2010) (Nabizadeh et al., 2012).

From the foregoing, treatment (14) days of irrigation frequency can be considered the most efficient in terms of the percentage of oil produced from the seeds without the effect of nitrogen fertilization.

Table 4. Effect of Nitrogen fertilization levels on the mean productivity of seeds and the mean oil seed content %

Nitrogen fertilization kg/ha (Greenup 43%)	yield (kg/ha)		oils seed %	
N0 = 0 (Control)	79,91	c	3,33	a
N1= 30 Kg/ha	141,757	ab	3,297	ab
N2= 40 Kg/ha	147,1	a	2,973	c
rep.	9		9	

d.f.	16	16
l.s.d.	11,06	0,23

The differences are statistically significant for (14) days of irrigation frequency.

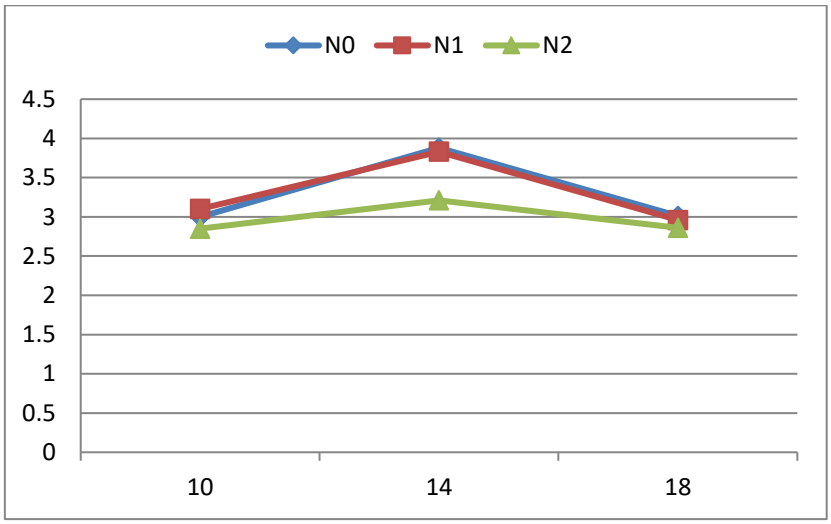

Fig.2. The effect of fertilization and irrigation treatment on aniseeds oil

3.Interaction effect of irrigation intervals and Nitrogen fertilization on t seed yield and the mean oil seed content

The interaction effect of nitrogen fertilization and irrigation intervals on seed yield were noted in Table. 5. It shows a clear effect of the interaction between irrigation intervals and nitrogen fertilization on the oil content of the seeds, with the superiority of treatment (Irri.1 =14) days of irrigation intervals in both of control and N1=30 kg/ha Nitrogen fertilizer. with significant differences compared to all other treatments and with an average oil percentage of 3.88%, 3.86%, respectively. While the differences were apparent between the treatments (10) and (18) days of irrigation intervals, that oil percentage averages were (2.98%) and (2.97%), respectively. This is consistent with the results of a study (Laribi et al., 2009, Kumar et al., 2008) due to the positive effect of limited water supply, regarding secondary metabolite biosynthesis, enzyme activities and solute accumulation (Sangwan et al., 2001). Deficient irrigation alters plant behaviour with respect to the biosynthesis of primary and secondary metabolites. In addition, drought affects the biosynthesis of essential oils (Laribi et al., 2009) and thus affects the composition of the essential oil.

The interaction effect of nitrogen fertilization and irrigation intervals on seed yield shows a significant superiority of the treatment Irri.1_N2 on all other treatments, except for the treatment Irri.1_N1, that means, the positive effect of nitrogen fertilization was significant when we apply the treatment 10 days of irrigation intervals, and we can get the same effect with lower level of fertilizer 30 kg/ha.

According to the interaction effect of nitrogen fertilization and irrigation intervals, the treatment (14) days of irrigation intervals can be considered as the most efficient in terms of the percentage of oil produced from the seeds, considering the effect of nitrogen fertilization. Whereas the treatment (10) days of irrigation intervals can we consider as the most efficient in terms of the percentage of seed yield, considering the effect of nitrogen fertilization.

In addition to that, we notice from the table. 5 that the treatments Irri.3_N1 and Irri.3_N2 have significantly the lowest levels of seed yield and oil content%.

Table 5. Interaction effect of irrigation intervals and Nitrogen fertilization on t seed yield and the mean oil seed content %

Interaction Irri * N_fer		yield (kg/ha)		oils seed %	
Irri.1	N0	128,4	d	3	f
	N1	186,4	ab	3,1	e
	N2	191,6	a	2,85	i
Irri.2	N0	66,4	e	3,88	a
	N1	163,8	c	3,83	ab
	N2	176,5	bc	3,21	c
Irri.3	N0	44,9	f	3,1	d
	N1	75,1	e	2,96	g
	N2	73,2	e	2,86	h
rep.		3		3	
d.f.		16		16	
l.s.d.		13,38		0,5449	

Recommendations:

Based on the results of seeds productivity under deferent irrigation frequencies; we recommend that the (14) day irrigate, with (30) Kg\ha, nitrogen fertilization, green up; has the best possible productivity of dry aniseeds. and oil seeds rates under the effect of deferent irrigation frequencies, we recommend the (14) day frequency of irrigation; which has best oil rate of seeds. we recommend avoiding watering shortly after harvest to prevent weed invasion. Also, long periods between harvesting can reduce weed spread.

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تأثير تواتر الري بتطبيق عدة مستويات من التسميد الآزوتي على محصول اليانسون(*Pimpinella Anisum*) (كماً ونوعاً)

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الملخص

من أجل تقييم تأثير تواتر الري والتسميد النيتروجيني في نسبة زيت بذور اليانسون وإنتاجية المحصول، أجريت تجربة في أرض محطة الطيبة التجريبية لمركز البحوث في ريف دمشق التابع للهيئة العامة للبحوث العلمية الزراعية خلال موسمين 2015 ، 2016. درس تأثير عاملين: تواتر الري (10 ، 14 ، 18) يوماً وذلك حسب السعة الحقلية، ومعدل تسميد النيتروجين (0، 30، 40) كغ/هكتار، (green up) 43٪ N2، واستخدم معدل البذار (20.5) كغ/هكتار، أظهرت النتائج تأثير واضح لتواتر الري على الإنتاجية، مع تفوق كبير في معاملة (10) يوم من تواتر الري، والتي كانت أعلى إنتاجية فيها (168.81) كغ/دونم، كانت الفروق ذات دلالة إحصائية لـ (14) يومًا من تواتر الري، مع (30) كغ/هكتار سماد، والأكثر إنتاجية من اليانسون، وكذلك (14) يومًا من معدل تواتر الري هو الأفضل في نسبة الزيت (3.64٪) دون تأثير تسميد النيتروجين.

الكلمات المفتاحية: اليانسون، تواتر الري، التسميد الأزوتي، معدل زيت بذور اليانسون.