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The effect of sowing dates on growth, yield and chemical compositions of *Withania somnifera* L. Dunal (Ashwagandha)

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Abstract

The experiment was conducted to study the effect of sowing dates on growth, yield and chemical composition of Ashwagandha (*Withania somnifera* L.) sown at Medicinal and Aromatic Plants fields of the College of Agriculture, Basra University, Iraq, during the growing season of 2013/2014 and 2014/2015. The experiment was laid out in Randomized Complete Block Design having three replications. The experiment involved sowing dates at three levels of 1or20 September and 10 October.The results showed that the all growth characters and chemical composition and nutrient contain of Ashwagandha plants as affected by different sowing dates.

Key words: Winter Cherry, Sowing dates.

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1. Introduction

Medicinal plants are wonder gifts of nature which are used as medicine, cosmetics, hygiene and food supplements in improving the quality of human life [1]. *Withania somnifera* (Solanaceae), is an annual to perennial herb, with multiple medicinal properties. known in India as Ashwagandha or winter cherry, is one of the most valuable plants of the traditional Indian systems of medicines, is used in more than 100 formulations of Ayurveda [2]. All parts of Ashwagandha have medicinal properties and are used in preparation of various drugs, however, roots are mainly used for preparation of vital tonics. It is tonic, general tonic in arthritis and debility from old age.

Fig.1- *Withania somnifera*

It is used in anxiety, depression, phobias, alcoholic paranoia, schizophrenia etc. The active ingredient that attributed to the medicinal property is the alkaloids and steroidal lactones.[3,4,5,6]. The environmental factors explicitly influence growth and development and yield of medicinal herbs. Sowing date is a very important parameter in crop production. The optimum sowing date paves the way for better use of time, light, temperature, precipitation and other factors [7]. In this experiment an attempt was made to study the influence of sowing date on vegetative growth , fresh and dry weight of leaves and roots and chemical components of *Withania Somnifera* (L.).

2. Methods

Experimental Design:-

The study on the effect of sowing dates on growth, yield and chemical composition of Ashwagandha was conducted at Medicinal and Aromatic Plants fields of the College of Agriculture, Basra University, Iraq, during the growing seasons of 2013/2014 and 2014/2015. The experiment was laid out in RCBD design with three replications. There were three treatment combinations comprised of three dates of sowing (Sep.1st, Sep. 20th and Oct.10th. The seeds were sown in small pots with the size (180cm3) and then transplanted in large size pots (900 cm3) when Seedlings aged 5 month. Tables (1& 2) explains the chemical, physical, soil mixture and irrigational water used in this experiment.

Tables 1 & 2- explains the chemical, physical, soil mixture and irrigation water used in this experiment.

Table 1 soil mixture & Irrigation water		
Characterize	Season1	Season2
(E.C)	5.03	5.04
(pH)	7.32	7.30
Total nitrogen(ml.l^{-1})	0.85	0.90
Phosphorus(ml.l^{-1})	17.76	20.85
Potassium(ml.l^{-1})	22.18	30.04
Organic matter%	0.38	0.40
Separates of soil		
Sand%	46.90	46.51
Silt%	18.00	20.04
Clay%	14.00	13.11
Soil texture	Sandy silt	
Irrigation water		
(E.C)	40.2	40.3
(pH)	7.90	7.92

Table 3 - maximum and minimum temperature grades and relative humidity for two seasons

Month	2013/2014		
	Temperature		Humidity%
	Max.	Min.	
September	42.23	24.79	19.26
October	33.41	17.33	26.84
2014/2015			
September	41.48	27.45	19.87
October	30.88	18.86	22.47

Measurements

Immediately after harvest, three plants in each replication were used for measurement of factors. Measured factors consisted of :-

1. **Plant Growth Characteristics**

plant's height, branch number. plant^{-1}, Leaf number. plant^{-1}, leaf area, fresh and dry weight of leaves and roots.

2. **Chemical Compositions**

A. Total chlorophyll content was measured by Spectrophotometer, according to Good [8].

B. Total carbohydrate in leaf and root was measured by Spectrophotometer, according to Dubois *et al* [9].

C .vitamin C was measured as described by A. O. A. C. [10].

3. **Nutritional Components**

A. Total nitrogen percentage (N %) by micro-Kjeldahl according to Page *et al.* [11].

B. Phosphorus content (P %) according to Olsen and Dean [12].

C. Potassium (K) and calcium (CA) content was measured by using Flame photometer.

4. **Fixed Oil percentage**

extracted fixed oil from leaves and roots by Soxhiet according to Stahl [13] using organic solvent ether petrolatum Spirit (Distillation range 40-60C °). percentage of fixed oil by applying the following formula: -

$$\text{Fixed Oil percentage (\%)} = \frac{\text{Fixed oil weight (g)}}{\text{samples weight (g)}} \times 100$$

3.Total alkaloid percentage

extracted fixed oil from leaves and roots by according to Harborn [14]. Percentage of total alkaloid applying the following formula: -

$$\text{Total alkaloid percentage (\%)} = \frac{\text{Total alkaloid (g)}}{\text{samples weight (g)}} \times 100$$

Statistical procedure

The data recorded from three plants were subjected to statistical analysis, using analysis of variance (ANOVA) using Gen Stat Release 10 statistical software. The differences among various treatments were analysed through Least Significant Difference test at probability of 0.05.[15].

3. Results and discussion

A. Growth Characteristics

The growth characters of Ashwagandha plants as affected by different sowing dates, tables (4). Regarding plant high, it could be easily noticed that 10th Oct., had increased plant high significantly comparing with other dates in both growing seasons. The maximum increment for branches number was recorded on 20th Sep., more than the other sowing dates during both growing seasons. Number of leaves per plant had the highest values when plant sown on 20th Sep., for the first growing season, and plant sown on 10th Oct., for the second growing season.

However plants sown on 1st Sep., for the first season and 10th Oct., for the second season produced a significant maximum leaf area. Meanwhile, the variation in the average values of fresh and dry weight for leaves and root for different sowing dates was significantly increased. The maximum fresh and dry weight of leaves and fresh weight of roots during the first season, was obtained of plants sown on 1$^{st\ Sep.}$, and during the second season was obtained of plants sown on 10th Oct. and 20th Sep.

Table 4- Effect of sowing dates on Growth Characteristics of *W. somnifera* (L.) during both growing seasons

Sowing dates	Plant high	No. of branches	No. of leaves	Leaf area (m^2)	Fresh weight(g/plant)		Dry weight(g/plant)	
					Leaves	Roots	Leaves	Roots
Season (2013/2014)								
D1	39.6	22.83	188.02	0.65	47.30	8.59	8.94	1.73
D2	47.1	25.00	199.20	0.39	38.61	5.94	7.33	1.52
D3	43.6	24.44	125.95	0.22	20.80	6.78	4.67	1.74
L.S.D.	**5.21**	**1.49**	**7.38**	**0.09**	**2.87**	**0.88**	**0.92**	**N.S**
Season (2014/2015)								
D1	29.6	9.23	59.94	0.13	16.01	1.78	2.54	0.24
D2	35.1	12.75	67.83	0.17	19.10	2.99	4.01	0.31
D3	38.5	10.25	79.79	0.25	21.44	2.94	4.46	0.57
L.S.D.	**3.34**	**1.86**	**5.93**	**0.03**	**2.29**	**0.63**	**1.03**	**0.12**

*** D1:-1 September, D2 :- 20 September, D3 :-10 October.**

B . Chemical compositions

The chemical compositions of Ashwagandha plant as affected by different sowing dates. The delay in sowing from 1st Sep., to 10th Oct., increase the total chlorophyll and vitamin C during the first growing season only, table (5). Highly total chlorophyll during the second season, produced by plants sown on 1st Sep. The maximum carbohydrate of leaves during the first and second growing seasons was obtained by plants sown on 1st Sep., and 20th Sep. Also plants sown on 20th Sep produced significantly maximum levels of carbohydrate of roots during the first growing season.

Table 5- Effect of sowing date on chemical compositions of *W. somnifera* (L.) during both seasons

Sowing dates	Season (2013/2014)			
	total chlorophyll content (ml.100 gm^{-1})	vitamin c (ml.100 gm^{-1})	total carbohydrates (ml. gm^{-1})	
			Leaves	Roots
D1	47.98	3.33	27.09	25.91
D2	53.96	3.46	26.53	26.15
D3	63.96	4.67	25.63	25.48
L.S.D.	**4.13**	**0.83**	**0.33**	**0.61**
Season (2014/2015)				
D1	38.67	2.45	24.70	25.65
D2	23.72	2.62	25.24	26.12
D3	28.47	2.42	24.84	26.17
L.S.D.	**3.51**	**N.S**	**0.36**	**N.S**
*** D1:-1 September, D2 :- 20 September, D3 :-10 October.**				

C. Nutritional contents

The nutritional contents of Ashwagandha affected by different sowing dates. Data presented in Table (6) revealed that sowing dates were of a significant effect of macro nutrients (N, P, K and Ca) in leaves and roots, except for the nitrogen and potassium of roots and phosphorus of leaves during both seasons. The maximum percentage of nitrogen in leaves and phosphorus in roots during the first season were obtained by plant sown on 1$^{st\ Sep.}$ followed by other sowing dates. Also the highest percentage of phosphorus and calcium in roots was obtained by plant sown on 20th Sep. during the second season only. Furthermore, plants sown on 10th Oct. during the second season gave maximum percentage of calcium in leaves.

Table 6- Effect of sowing dates on nutritional contents of *W. somnifera* (L.) during both seasons

Sowing dates	Season (2013/2014)							
	%N		%P		%K		%Ca	
	Leaves	roots	Leaves	roots	Leaves	roots	Leaves	roots
D1	8.81	5.14	3.25	4.95	3.42	2.80	2.73	1.31
D2	7.58	4.36	3.25	4.10	4.32	2.56	2.79	1.41
D3	4.89	3.91	3.16	4.64	4.40	2.30	2.78	1.37
L.S.D.	**2.20**	**N.S**	**N.S**	**0.33**	**0.90**	**N.S**	**N.S**	**N.S**
Season (2014/2015)								
D1	7.90	5.08	2.70	4.79	3.40	3.17	2.43	1.73
D2	7.47	4.41	2.91	5.20	4.16	3.05	3.09	2.55
D3	6.01	5.55	2.75	4.53	4.26	2.72	3.37	1.99
L.S.D.	**N.S**	**N.S**	**N.S**	**0.60**	**N.S**	**N.S**	**0.79**	**0.63**
*** D1:-1 September, D2 :- 20 September, D3 :-10 October.**								

D. **Percentage of fixed oil and total alkaloid**

Evident from the data related to percentage of fixed oil and total alkaloid presented in Table (7) the effect of sowing dates was not significant during both growing seasons.

Table 7- Effect of sowing dates on percentage of fixed oil and total alkaloid of Ashwagandha during both seasons

Sowing date	fixed oil %				Total alkaloid %			
	Season (2013/2014)		Season (2014/2015)		Season (2013/2014)		Season (2014/2015)	
	Leaves	roots	Leaves	roots	Leaves	roots	Leaves	roots
D1	0.54	0.46	0.40	0.39	7.78	7.91	13.84	10.16
D2	0.57	0.54	0.47	0.47	6.66	8.78	14.63	13.39
D3	0.62	0.50	0.47	0.48	10.34	8.37	12.75	12.09
L.S.D.	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**	**N.S**
*** D1:-1 September, D2 :- 20 September, D3 :-10 October.**								

4. Discussion

Planting dates is of the most important factors to be taken into account when the cultivation of any plant, as the different planting dates regularly mean a difference in environment such as temperature, light, humidity and other factors that reflect plant growth and development and the quality and quantity of production factors [16]. The vegetative growth shown of high plant and number of branches, leaves and leafy area of strength and signs of growth, which in turn influenced by the quantity and quality of nutrients absorbed and environmental conditions surrounding the plant also affect the dates of the various agriculture. The early sown plants may be due to the growth in the availability of the appropriate environmental conditions for vegetative growth which has worked to increase the efficiency of photosynthesis that reflected positively in the strength of plant growth such as number of branches and leaves ,fresh and dry weight of leaves and roots [17]. This result agrees with [18] and [19] to *Foeniculum vulgare* Mill. The increased branches may be due to the availability of food manufacturers needed to stimulate the buds on plant growth and compared to plants cultivated late deadlines amount (20). This result agrees with [21] to fennel plants ,Or increase the efficiency of photosynthesis and the accumulation of metabolites that stimulate cell division and the emergence of new vegetative growth of total heavy vegetative growth represented by the number of branches , number of leaves. This result agrees with . [22] a to *Pimpinell anisum* L . Plants growing in the early dates led to increased leaf area compared to those cultivated in the late dates due to different environmental conditions of temperature, humidity and lighting in the different planting dates.The exceed of early plants in the content of carbohydrates may be due the reason that plants growth under favorable weather conditions led to the length of the vegetative growth period and abundance represented by increasing the number of branches and vegetative number of leaves and leaf area which led to increase the efficiency of photosynthesis, which reflected significant increase in processed food in stock accumulation and delayed transmission of those manufactured materials to the centers polarization (flowers and fruits) which provided carbonate needed to build the amino acid structures led to increase the total chlorophyll and vitamin c contents [23].

The exceed of early plants in the nutritional contents, may be due the plants growth under favorable weather conditions led to the length of the vegetative growth period and abundance represented by increasing the number of branches and vegetative number of leaves and leaf area which led to increase the efficiency of photosynthesis, which reflected significant increase in processed food in stock accumulation and delayed transmission of those manufactured materials to the centers polarization (flowers and fruits) which provided carbonate needed to build the amino acid structures led to increase the nutritional contents.

5. Conclusion

The results showed that early sowing had the optimum yield the following traits revealed the largest quantities: "main branch number, leaves number per stem, plant height. And chemical composition of Ashwagandh.

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