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Response of Seed Yield and its Components to Autumn and Spring Sowing Dates of Alfalfa (*Medicago sativa*)

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Abstract

This investigation was carried out at Agronomy Department Farm, Faculty of Agriculture, Assiut University, Egypt, to study the effect of temperature resulting from different sowing dates, genotypes and their interaction on seed yield and its components of alfalfa. A set of ten genotypes namely; Ismailia-1, Nubaria-1, Ramah-1, populations from Forage researcher section (F.R.S.), Kharja, El-Dakhla, Farafra, Balady, Aswan, and Cuf 101, were subjected to five sowing dates (three autumns, *i.e.* October 10th (D1), November 10th (D2) and December 10th (D3), and two springs [March 20th (D4) and April 20th (D5)]. Two experiments were carried out as (2017-2019) and (2018-2020). Each experiment included all autumn and spring sowing dates. The split block design with three replications was used in both experiments. In the second year of growth for each sowing date, plants was left for flowering and seed production. The results showed that sowing dates and genotypes had significant effect on number of seeds and number of pods/plant, number of seeds/pod, seed yield and 1000-seed weight, except for 1000-seed weight that was insignificant among studied genotypes in experiment I. Also, the interaction between sowing dates x genotypes were significant for all studied traits in the two experiments except for seed yield/m^2 and 1000-seed weight that were insignificant in experiment I. The highest mean values of number of pods/plant were obtained from sowing in fifth (April D5) and first sowing dates (October D1) in experiments I and II, respectively. While, sowing at March (D4) gave the highest mean values of seed yield/m^2.

Furthermore, the maximum 1000-seed weight was obtained from sowing at December 10th (D3) date in both experiment. It was clear that Aswan genotype, produced the highest seed yield and heaviest 1000 seed weight in the two experiments.

The correlations between seed yield and each of its components for each sowing date in each experiment showed different values, indicating different relationships among the studied traits.

Keywords: *Alfalfa, Medicago sativa, Lucerne, Sowing date, seed yield and yield components, Correlation.*

Introduction

Alfalfa or Lucerne (*Medicago sativa* L.) is a highly productive forage legume of global importance. Being a long-lived perennial, it had been called "The king of the Forages". It is one of the most important forage species in many countries for high production. In Egypt, the total cultivated area of was about 73321 faddan (one faddan = 4200 m^2) with an estimated productivity of about 1953422 tons of green fodder (B.A.S, 2018). Because of alfalfa can fix nitrogen and synthesize protein, it is very useful to farmers, who have grown alfalfa as protein-rich fodder for cows, goats, sheep, chickens and others. Also, it is cultivated over a wide range of climatic and edaphic conditions ranging from the semi-arid regions to the humid areas. Therefore, this crop plays a significant economic role in the market of animal feed (*i.e.;* hay, dehydrated forage, pellets, and silage products) and a great effort have been made to improve its forage quality. It has been an important agronomic feature in restoring soil structure by roots which create holes in the soil for air and water, as well. Some farmers also used alfalfa plants as a green manure throughout plowing it into the soil to improve soil fertility. Moreover, alfalfa needs only low fertilizer inputs and herbicides or pesticides, consequently, it has a positive public concern about the environmental impact of agricultural system. A propose of the other benefits *i.e.* some people consume alfalfa honey.

Current changes in the climatic conditions towards warming especially in Egypt are expected to prolong the summer season and shorten the winter or other seasons during alfalfa growth. Thus, it was desirable to change the planting date of alfalfa to avoid the high or low temperature effects at the beginning of the fall season.

Alfalfa seed production has always been almost low. And thus a little research interest has been shown towards its improvement (Kowithayakorn and Hill, 1982). Seed yield are usually under severe influence of environmental conditions, genetic characteristics and agricultural techniques (Iannucci and Martiniello, 1998 and Sengul, 2006). Few researches have been conducted on the effect of temperature resulting from different, sowing dates and the effect of genotype x environment interaction on seed yield production of alfalfa. With this respect Huyghe *et al.* (2001) found that the genetic variance for seed yield was large but the cultivar x environment variance was small. Bakheit *et al.* (2017b) found that the highest number of pods/plant and 1000-seed weight of alfalfa were obtained from sowing at 20th November, while seed yield increased when sowing date was performed at October 20th in both study seasons. Also, Bolaños-Aguilar *et al.* (2000) and Abd El-Rady (2018) found large variation in seed yield among cultivars and environments.

Variation in weather conditions at various stages of plant development may affect the different response of genotypes to environments. Because, alfalfa genotypes are being grown under a wide range of conditions, they are exposed to different soil types and fertility levels, moisture levels, temperatures and cultural practices *i.e.,* sowing dates. All the variables encountered in producing alfalfa can be described collectively as the environment. Therefore, when alfalfa genotypes are compared in different environments, its performance relative to each other may not be the same. These changes in the relative performance of genotypes across different environments are referred to as genotype x environment interaction.

Little information are available in Egypt regarding the influence of change in climatic conditions resulting from different planting dates on seed yield production of alfalfa.

Therefore, the objectives of current study were; 1) determine the influence of temperature conditions resulting from six different sowing dates on seed yield and its components of genotypes under Assiut conditions and 2) study the nature of association between seed yield and their contributing variables *via* correlation coefficient.

Materials and Methods

This work was carried out at the Agronomy Department Experimental Farm, Faculty of Agriculture, Assiut University, Assiut, Egypt (27.19 N, 31.16 E; clay soil) during the three growing years from 2017 to 2020 in two experiments.

The physical and chemical properties of the experimental soil of experiment I and II (2017-2020) were clay (49.4%), sand (25.9%), silt (24.7%), field capacity (44.2), soil pH (7.80), organic matter (1.62%), total nitrogen (0.09%) and $CaCO_3$ (1.20%).

The materials for this study included nine genotypes from Egypt, namely: Ismailia-1, Nubaria-1, Ramah-1 (from F.R.S.), Kharja, El-Dakhla, Farafra, Balady, Aswan beside one introduced genotype from U.S.A. namely Cuf101.

Two experiments were carried out as experiment I (2017-2019) and experiment II (2018-2020). Treatments involved three autumn sowing dates, *i.e.;* 10th October (D_1), 10th November (D_2) and 10th December (D_3) and three spring sowing dates, *i.e.;* 20th March (D_4), 20th April (D_5) and 20th May (D_6). The sowing date of 20th May (D6) in both experiments did not germinated under Assiut condition.

A split block design with three replications was used in both experiments. Sowing dates were arranged in vertical strips and the genotypes in horizontal strips.

Plot size was one meter square (three meters long x 33.5 cm) used to detect the seed yield and its components. Alfalfa seed were broadcasted by hand at the rate of six g/m^2 (plot).

All cultural practices were maintained at optimum level for maximum alfalfa productivity.

In the second year for each sowing date, the plants was left for flowering and seed production in the first week of each March for D_1 and D_4, April for D_2 and D_5 and May for D_3 in the two experiments.

Data recorded

Seed yield and its components:

At seed maturity stage, the data were recorded as follows:

1- **Number of pods/plant (NPP)**: A random sample of ten plants was taken from each plot. The average number of pods/plant had recorded.

2- **Number of seeds/pod (NSD)**: average of seeds from 500 pods was recorded.

3- **Number of seeds/plant (NSP):** Number of pods/plant x number of seeds/pod.

4- **Seed yield/plant (g) (SYP)**: A random sample of ten plants had taken from each plot. Plants were harvested at seed maturity stage. The average of seed yield/plant was recorded.

5- **Seed yield/plot, (g) (SYW):** plants had harvested at seed maturity stage and were manually threashed.

6- **1000 seed weight (seed index) (g) (SI)**: From each plot, five samples each of 1000 seeds were weighted. The average of 1000-seeds weight was recorded.

Climatic data during the period of growing seasons including maximum and minimum daily temperature and sun shine (Table 1). The total growing degree days (GDD), (base= 7) was calculated for each sowing date according to Saeed and Francis (1984**)** as follows:

Total growing degree days (GDD) =

Σ[((Maximum + Minimum temperature)/2)-7]

Where, 7= Zero growth point of activity for alfalfa.

Statistical analysis:

Data analysis was performed according to Gomez and Gomez (1984). The variances of all studied traits, between the two experiments were found not homogenous, consequently the combine analysis was not performed. Means were compared using L.S.D. test at 5 and 1% levels of probability.

Phenotypic correlations:

The phenotypic correlation across sowing dates as well as genotypes in each of experiment-1 (2019) and experiment-2 (2020) for seed yield and its components were calculated as outlined by Walker (1960).

Results and Discussion

Sowing dates used to evaluate the genotypes performance in this recent study, provided a range of variation in seasonal climate. The climatic conditions *i.e.;* average temperature and sunshine (Table 1), and total Growing, Degree Days (GDD) were of different values during the two experiments of seed yield (Table 2).

Table 2. Total growing degree days (GDD) for each sowing dates in each experiments at Assuit alfalfa trials.

Sowing date	GDD until seed maturity	
	2019	2020
10th October	1650	1592
10th November	2007	1917
10th December	2264	2215
20th March	1990	1954
20th April	2376	1917

Seed yield and its components:

1- Number of pods/plant:

Number of pods/plant is one of the components that determine seed yield. The analyses of variance for number of pods/plant in 2019 (experiment I) and 2020 (experiments II) were shown in Table 3.

The analysis of variance revealed highly significant influenced of sowing dates in the two experiments. Also, it was highly significant among genotypes in both experiments. Moreover, the interaction between sowing dates x genotypes was of significant effects in both experiments.

The average number of pods/plant in the experiment I and II as affected by five sowing dates and ten genotypes were presented in Table 4.

The highest number of pods/plant of 78.33 was in plants sown at April 20th (D5) in experiment I and 158.37 at October 10th (D1) in experiment II. In these two planting dates, plants were left to flower at the first of April. The difference between the two experiments for number of pods/plant might be due to the different climatic conditions (temperature, relative humidity and sun shine (Tables 1 and 2). It was clear that, plants sown at December 10th (D3), produced the least number of pods/plant of 30.07 and 91.60 in experiments I and II, respectively.

Number of pods/plant of the ten genotypes over all sowing dates revealed that Cuf101 genotype produced the highest number of pods/plant of 66.67 and 161.29 in the experiments I and II, respectively. It was also evident that Cuf101 (119.33) and Balady (199.00) populations sown on April 20th (D5) produced the highest number of pods/plant in experiments I and II respectively.

With this respect, Bakheit *et al*. (2017b) reported the highest number of pods/plant was obtained from sowing at the November 20th. Also, Abd-El-Rady (2018) found differences among alfalfa genotypes for the number of pods/plant.

2- Number of seeds/ pod:

Number of seeds/pod is one of the essential factor in determining the seed yield. The analyses of variance for number of seeds/pod in experiment I (2019) and experiments II (2020) were presented in Table 3. The analysis of variance revealed a highly significant differences among the five sowing dates in both experiments. These results confirm the variable response of alfalfa genotypes to sowing dates.

The interaction between sowing date and genotype had significant effect on number of seed/pod in both experiments.

Mean number of seeds/pod in experiments I and II were presented in Table 5. The highest number of seeds/pod were recorded on November 10th (D2) that was left to flower at the first of April in both experiments 2.0 and 2.01 in experiment I and II, respectively,.

This might be due to the suitability of sowing and flowering dates that which coincide with the activity of pollinators (honey bees) that plays a great role in tripping and seed setting by under Assiut Governorate conditions.

Results in Table 5 showed that, Balady population produced the highest number of seeds/pod (1.83 and1.30 in experiments I and II, respectively). Also, Aswan population gave the highest number of seeds/pod of (2.57) when sown on November 10th (D2) and flowered at the start of April in experiment II. Moreover, Ramah-1 genotype gave the highest number of seeds/pod (2.30) with sowing at November 10th (D2) in experiment I. With this respect, Ram *et al*. (2014) in India found the minimum value of number of seeds/pod was registered under sowing at 1st November. While, Bakheit *et al*. (2017a) in Egypt reported that, the highest number of seeds/pod was obtained from sowing at December 20th in a results of two seasons. Abd El-Rady (2018) in Egypt found a significant differences among seven alfalfa varieties for number of seeds/pod.

3- Number of seeds/plant:

Analysis of variance for number of seeds/plant of the ten genotypes of alfalfa under five sowing dates during the two experiments was presented in Table 3. The results indicated that sowing dates were highly significantly affected the number of seeds/plant in both experiments. Also, the number of seeds/plant was highly significantly affected by studied genotypes in both experiments. Moreover, sowing dates x genotypes interaction had a highly significant and significant effects in experiments I and II, respectively.

Means of number of seeds/plant in the two experiments as affected by five sowing dates and ten genotypes were shown in Table 6.

The highest mean value of number of seeds/plant (112.5) was obtained from plants sown on April 20th (D5) and left to flower in the start of April in experiments I. Also, the highest value (215.1) was obtained from plants sown on November 10th (D2) and left to flowering in first of April in experiments II. This might be due to differences in climatic conditions between the two experiments (Tables 1 and 2). On the other hand, April month was the most suitable time for flowering and pollination that, coincide with the activity of pollinators (honey bees). These results are in agreement with that reported by Medeiros *et al*. (1995) who reported that high temperatures during flowering probably limit insect pollination and enhance physiological losses of pollinated flowers and increase embryo abortion. Thus, the flowering at April might be more favorable for seed production.

Comparing the genotypes over the five sowing dates (Table 7) for number of seeds/plant revealed that, Aswan population gave the highest values of 102.34 and 166.94 in experiments I and II, respectively.

It was also evident that Aswan population sown on April 20th in experiment I (D5) or sown on October 10th (D1) in experiment II, produced the highest number of seeds/plant.

These results are in agreement with those obtained by Abd El-Rady (2018). He found a significant differences among alfalfa genotypes for number of seeds/plant.

4- Seed yield/plant (g):

The analysis of variance of seed yield/plant of the ten genotypes of alfalfa under five sowing dates during the two experiments was presented in Table 3.

The results indicated that sowing dates had a highly significant that on seed yield/plant in the two experiments. It was highly significantly affected by genotype in both experiments. Moreover, sowing dates x genotypes interaction had a significant effect in the two experiments (Table 3).

The mean number of seed yield/plant in the two experiments as affected by five sowing dates and ten genotypes were shown in Table 7.

The response of the studied genotypes under different sowing dates varied from season to another. This result might be due to the large differences in climatic conditions prevailing in these sowing dates (Tables 1 and 2). The presence of these interactions suggested a different response of the genotypes to variable sowing dates.

Similar results were obtained by Medeiros *et al*. (1995) in alfalfa, Iannucci and Martiniello (1998) in annual clover and Ranjbar (2007) in berseem clover.

It was evident that the minimum seed yield/plant of 0.15 and 0.17 (g/plant) were obtained when sowing was performed at December 10th (D3) in experiment I and at March 20th (D4) in experiment II, respectively. On the other hand, seed yield/plant significantly decreased as sowing date was delayed in experiment II only**.** But, the seed yield/plant increased when sowing was at April 20th in experiment I and November 10th in experiment II where, plants were left to flower at the start of April.

Data also, showed that the first and second sowing dates, gave significantly higher average of seed yield/plant than other dates in experiment II only. These results might be due to that the most suitable time for flowering and pollination much with the first and second sowing dates which coincide with the activity of pollinators that play a great role in increasing seed setting through tripping. These results are in line with those reported by Dobrenzo *et al.* (1965) and Avice *et al*. (1997).

Over the five sowing dates**,** Aswan population gave the highest values of 0.29 and 0.43 g/plant in experiments I and II, respectively.

It was also evident that, Cuf101 sown on April 20th in experiment I (0.46) and Balady population sown on November 10th in experiment II (0.77) gave the highest seed yield plant (plants left to flower at first of April in both experiments).

These results are in agreement with those obtained by Abd El-Rady (2018). He found a significant differences among alfalfa genotypes for seed yield/plant which increased when sowing date was performed at October 20th in two seasons.

5- Seed yield/m^2 (g):

The analysis of variance of seed yield/ m^2 in experiments I (2019) and II (2020) years are presented in Table (3). The analysis of variance showed that, sowing dates and genotypes were highly significantly different in seed yield/ m^2 in both experiments. The interaction between sowing date and genotype was insignificant and significant in experiment I (2019) and experiment II (2020), respectively.

These results indicated that, the response of the studied genotypes under different sowing dates varied from experiment to another. This might be due to different climatic conditions prevailing in those sowing dates (Tables 1 and 2).

The presence of these interaction suggested a differential response of genotypes to varied sowing dates. Similar results were obtained by Medeiros *et al*. (1995).

The average seed yield/m^2 as influenced by sowing dates and genotypes for experiment I (2019) and II (2020) years are presented in Table 8. It was evident that the maximum seed yield/m^2 of 66.1 and 59.1g/m^2 were obtained when planting date was April 20th (D4) and plants was left to flower at first of March in experiments I (2019) and II (2020), respectively.

Temperature conditions during growth, flowering, pollination and seed maturity for each sowing date were quite different and this had a significant impact on the results. These results suggest that allowing plants to flower at first of March was the most suitable time for flowering and pollination, that, coincide with the activity of pollinators (honey bees) which play a great role in increasing seed setting by flowers tripping.

These results are in line with these reported by Dobrenzo *et al.* (1965) who found that the time required for flowering initiation decreased as the average of minimum temperature increased. Furthermore, Medeiros *et al.* (1995**)** reported that high temperature during flowering probably limit insect pollination and enhances physiological losses of pollinated flowers and increases embryo abortion. Thus, the time of first March probable more favorable for seed yield production.

Data in Table 8 show that, Aswan population significantly produced the highest seed yield/m^2 of 59.4 and 48.3 g in experiments I and II, respectively.

Considering the significant interaction in experiments II, the data in Table 8 indicated that Aswan population (75.15) and Ramah-1 (75.40) had the highest seed yield/m^2 when sown at March 20th (D4) and plant left to flower at first of March.

These results are in line with reported by Abd El-Rady (2018) and Ahmed *et al.* (2020). Abd El-Rady (2018) found a significant differences among seven alfalfa genotypes for seed yield/m^2. Also, he found that, Aswan genotypes had the highest seed yield/m^2. Ahmed *et al.* (2020), reported that, taking last cutting at March and plant left to flowering exhibited significantly the highest seed yield.

6- 1000-seed weight (seed index):

Analysis of variance for 1000 seed weight showed that, sowing dates had a significant effect in experiment I and highly significant effect in experiment II. Also, genotypes were insignificantly different in experiment I and highly significant in experiment II. The interaction between sowing date and genotype was only significant in experiment II (2020) (Table 3).

This might be due to the differences of temperature between seasons (Tables 1 and 2).

Means of 1000-seed weight in the two experiments as affected by sowing date and genotype were presented in Table 9. It could be studied that the heaviest 1000-seed weight (2.90 and 2.58) were obtained from sowing on December 10th in experiment I and experiment II, respectively. The average 1000-seed weight of the different sowing dates was decreased in early sowing dates. It was clear that, plants sown at the first sowing date (October 20th) had the lowest 1000 seed weight of 2.72 and 2.49 in experiments I and II, respectively. Kharja and Aswan populations had significantly heavier seeds in both experiments **(**Table 9).

These results are in line with those obtained by Ram *et al*. (2014), Bakheit *et al*. (2017a), Abd El-Rady (2018) and Ahmed *et al*. (2020). They found a significant differences among alfalfa genotypes for 1000-seed weight. Ram *et al*. (2014) reported that minimum value of 1000 seed weight was registered under sowing at 1st November. Bakheit *et al*. (2017a) revealed that the highest 1000 seed weight was obtained from sowing on the 20th November. Abd El-Rady (2018) found significant differences among seven alfalfa varieties in 1000 seed weight. Also, Ahmed *et al*. (2020) in Pakistan found that last cutting at 19th March exhibited significantly the highest 1000 seed weight.

Simple correlation coefficient analysis:

The simple correlations among seed yield traits in five sowing dates of both experiments were shown in Tables 10a, b, c, d, e.

In general the correlation coefficients for each sowing date and experiment showed different values of.

Seed yield/m^2 was correlated differently with each of number of pods/ plant, number of seeds/plant, number of seeds/pod, seed yield/plant and 1000-seed weight. the obtained values varied with sowing date and experiments.

For example, the values of correlations between seed yield/m^2 and each of previous traits in first sowing date (D1) were 0.802**, 0.854**, 0.108, 0.951** and 0.303 in experiment I, and 0.860**, 0.970**, 0.594, 0.972** and -0.137 in experiment II, respectively, (Table 10a).

While, correlations between the same traits in the second sowing date (D2) were 0.584, 0.879**, 0.459, 0.863**, and -0.147 in experiment I, and 0.841**, 0.955**, -0.702*, 0.940** and 0.427 in experiment II, respectively (Table 10b).

Table 10. Correlations among seed yield and their components for each and over sowing date in experiments I (above) and II (below diagonal).

a- First sowing date (D1)

	NPP	NSP	NSD	SYP	SYW	SI
NPP	____	0.805**	-0.224	0.806**	0.802**	0.031
NSP	0.823**	____	0.365	0.948**	0.854**	-0.180
NSD	0.214	0.718*	____	0.279	0.108	-0.365
SYP	0.804**	0.980**	0.700*	____	0.951**	0.137
SYW	0.860**	0.970**	0.594	0.972**	____	0.303
SI	-0.188	-0.217	-0.143	-0.023	-0.137	____

b- Second sowing date (D2)

	NPP	NSP	NSD	SYP	SYW	SI
NPP	____	0.650*	-0.209	0.657*	0.584	-0.124
NSP	0.863**	____	0.336	0.972**	0.879**	-0.167
NSD	-0.877**	-0.616	____	0.374	0.459	0.190
SYP	0.862**	0.978**	-0.634*	____	0.863**	0.059
SYW	0.841**	0.955**	-0.702*	0.940**	____	-0.147
SI	0.445	0.389	-0.424	0.571	0.427	____

c- Third sowing date (D3)

	NPP	NSP	NSD	SYP	SYW	SI
NPP	____	0.711*	-0.060	0.683*	0.443	0.069
NSP	0.636*	____	0.656*	0.987**	0.902**	0.029
NSD	-0.270	0.567	____	0.667*	0.810**	-0.024
SYP	0.640*	0.997**	0.562	____	0.921**	0.168
SYW	0.393	0.867**	0.683*	0.881**	____	0.175
SI	0.139	0.293	0.249	0.359	0.519	____

d- Fourth sowing date (D4)

	NPP	NSP	NSD	SYP	SYW	SI
NPP	____	0.687*	-0.433	0.720*	0.598	0.183
NSP	0.882**	____	0.352	0.991**	0.957**	-0.062
NSD	-0.044	0.426	____	0.293	0.426	-0.372
SYP	0.896**	0.991**	0.398	____	0.944**	0.065
SYW	0.783**	0.853**	0.340	0.884**	____	-0.075
SI	0.389	0.256	-0.068	0.375	0.450	____

e- Fifth sowing date (D5)

	NPP	NSP	NSD	SYP	SYW	SI
NPP	____	0.904**	-0.133	0.868**	0.815**	0.137
NSP	0.619	____	0.298	0.985**	0.912**	0.287
NSD	-0.767**	0.002	____	0.353	0.287	0.439
SYP	0.503	0.945**	0.101	____	0.947**	0.433
SYW	0.632	0.930**	-0.107	0.942**	____	0.415
SI	-0.233	0.105	0.415	0.407	0.198	____

Where, NPP= Number of pods/plant; NSP= Number of seeds/plant; NSD= Number of seeds/pod; SYP= Seed yield/plant; SYW= Seed yield/m^2; SI= 1000-seed weight.

Table 10f: over all sowing dates

	NPP	NSP	NSD	SYP	SYW	SI
NPP	_____	0.77**	-0.348*	0.754**	0.511**	-0.13
NSP	0.524**	_____	0.288*	0.986**	0.488**	-0.103
NSD	-0.278	0.593**	_____	0.291*	-0.270	0.054
SYP	0.520**	0.992**	0.580**	_____	0.520**	0.053
SYW	0.307*	0.138	-0.191	0.147	_____	0.145
SI	-0.068	0.002	-0.002	0.112	0.185	_____

Where, NPP= Number of pods/plant; NSP= Number of seeds/plant; NSD= Number of seeds/pod; SYP= Seed yield/plant; SYW= Seed yield/m^2; SI= 1000-seed weight.

The correlation for the same previous traits in the third sowing date were 0.443, 0.902**, 0.816**, 0.921** and 0.175 in experiment I and 0.393, 0.867**, 0.683*, 0.881* and 0.519 in experiment II, respectively (Table 10c).

The correlation values in the fourth sowing date (D4), in that same order were 0.598, 0.957**, 0.426, 0.944** and -0.075 in experiment I and 0.783**, 0.853**, 0.340, 0.884** and 0.450 in experiment II, respectively (Table 10d).

Furthermore, in fifth sowing date (D5), correlations values between the same traits were 0.815**, 0.912**, 0.287, 0.947** and 0.415 in experiment I and 0.632, 0.930**, -0.107, 0.942** and 0.198 in experiment II, respectively (Table 10e).

The correlation values among the previous traits over the five sowing dates for each experiment were presented in Table 10f.

Simple correlation coefficients calculated among seed yield characteristics in each experiment over all sowing dates were shown in Table 10f. Seed yield/m^2 was positively correlated with each of number of pods/plant, number of seeds/plant, seed yield/plant and 1000-seed weight in each experiment *i.e.* 0.511**, 0.488**, 0.520** and 0.145 in experiment I and 0.307, 0.138, 0.147 and 0.195 in experiment II, respectively. Also, the significant and positive correlations estimated between seed yield/plant and each of number of pods/plant, number of seed/plant, number of seeds/pod and seed/yield/m^2 of values 0.754** and 0.520**, 0.986* and 0.991**, 0.291* and 0.580**, and 0.520** and 0.147 in experiments I and II, respectively (Table 10f). While, seed index was negatively of negligible correlation with each of number of inflorescence/plant, number of pods/ plant, number of seeds/plant, number of seeds/pod, seed yield/plant and seed yield/m^2 (0.081, -0.13, -0.103, 0.054, 0.053 and 0.145 in experiment I and 0.038, -0.068, 0.002, 0.002, 0.112 and 0.185 in experiment II, respectively). These results indicate that the most effective components in seed yield of alfalfa would be number of pods/plant, number of seeds/plant and number of seeds/pod.

These results are in line with those obtained by Bolanos-Aguilar *et al.* (2000) and Sengul and Sengul (2006) who found positive and significant correlation between seed yield and pods number. Also, Sengul (2006) found that, seed yield was significantly positively correlated with the number of seeds/ inflorescences (r= 0.593) and number of pods/ inflorescence (r= 0.602). While, Abd El-Rady (2018) found that, seed yield per unit area was negatively correlated with each of number of pods/plant and number of seeds/pod. Also, negative correlations were found between 1000-seed weight with each of number of pods/plant and number of seeds/pod. But, positive relationship was found between seed yield and 1000-seed weight.

Very little information was available on alfalfa seed yield associations with inflorescences level. A large genetic variation among and within a variety of alfalfa for seed yield and its components was reported by Campbell and He (1997).

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استجابة محصول البذور ومكوناته لمواعيد الزراعية الخريفي والربيعي في البرسيم الحجازي

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الملخص

أجري هذا البحث في مزرعة قسم المحاصيل – كلية الزراعة – جامعة أسيوط، لدراسة تأثير درجات الحرارة الناتجة عن اختلاف مواعيد الزراعة خلال النمو الخضري ونضج البذور لبعض التراكيب الوراثية والتفاعل بينهما علي المحصول البذري ومكوناته في عشرة تراكيب وراثية من البرسيم الحجازي. تم زراعة العشرة تراكيب وراثية وهي (اسماعلية-١، نوبارية-١، رماح-١، وعشائر من قسم بحوث العلف، الخارجه، الداخله، الفرافرة، البلدي وأسوان بالإضافة إلي صنف كوفي ١٠١ من الولايات المتحدة الأمريكية) وخمسة مواعيد زراعة (ثلاثة خريفي وهي ١٠ أكتوبر، ١٠ نوفمبر، ١٠ ديسمبر) وأثنين ربيعي (٢٠ مارس ، ١٢ أبريل) في تصميم الشرائح الكاملة العشوائية باستخدام ثلاث مكررات في تجربتين حيث نفذت الأولي خلال الأعوام (٢٠١٧-٢٠١٩) والثانية خلال الأعوام (٢٠١٨-٢٠٢٠). وكل تجربة شملت الخمسة مواعيد زراعة والعشرة تراكيب وراثية في السنة الثانية لكل تجربة ولكل ميعاد زراعة تركت النباتات للتزهير وإنتاج البذور بداية من مارس وحتي مايو حسب ميعاد الزراعة.

وكانت أهم النتائج المتحصل عليها كما يلي:

١- كان لمواعيد الزراعة والأصناف تأثير معنوي لعدد البذور وعدد القرون/النبات وعدد البذور في القرن ومحصول البذور ووزن ١٠٠٠ بذرة في كلا التجربتين فيما عدا وزن ١٠٠٠ بذرة بين التراكيب الوراثية في التجربة الأولي كان غير معنوي، كان التفاعل بين مواعيد الزراعة × التراكيب الوراثية معنوي لكل الصفات في كلا التجربتين ما عدا وزن البذور/م٢، ووزن ١٠٠٠ بذرة في التجربة الأولي كان معنوي.

٢- تم الحصول علي أعلي قيمة لعدد القرون/النبات عند الزراعة في شهر أبريل وشهر أكتوبر في التجربة الأولي والثانية علي التوالي، بينما الزراعة في شهر مارس أعطي أعلي قيمة محصول البذور/م٢ وأعطت الزراعة في ديسمبر أثقل وزن ١٠٠٠ بذرة في كلا التجربتين.

٣- أعطت عشيرة أسوان أعلي محصول بذري وأثقل وزن ١٠٠٠ بذرة في كلا التجربتين.

٤- اختلف الارتباط بين محصول البذور ومكوناته في مواعيد الزراعة المختلفة.