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Influence of ecological factors on seed setting and fertility of five Egyptian clover (*Trifolium alexandrinum* L.) cultivars

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ABSTRACT

Five Egyptian clover cultivars were evaluated for the fertility traits under different environmental conditions for four blooming periods. The study was conducted in Randomize Complete Block Design with three replications at Agricultural Research Center (ARC) in Giza Station during winter 2008-2009 and 2009/2010 seasons. Three cuts were taken during the two seasons and total forage and dry yield were analyzed as a total yield over the two seasons. The effect of temperature, and relative humidity on many of the attributes of plant flowering (the speed of dispersal of pollen, matured pollen, vitality of pollen grain, pollination and fertility and increased of seeds), while affecting of wind speed and sunshine duration on the movement and the activity of pollinators, especially honey bees and its role in floret pollination, which leads to increase seed production. Helaly-1 cultivar was demonstrated high seed set, over the two seasons, 17.77%, 29.10%, 42.48% and 56.65% in all blooming dates except for the fourth date followed by Giza-6 cultivar was the superior seed set of the fourth blooming date (58.35%). The four blooming dates set seed over the two seasons recorded 13.70% of the first date, 28.30% of the second date, 39.78% of the third date and 55.12% for the fourth date. Heritability over two seasons indicated 94.78%, 93.20%, 91.34% and 81.50% of the first, second, third and fourth blooming dates, respectively. The local cultivars Helali-1 and Giza-6 were generally higher than Sakha-4, Gemmiza-1 and the cultivar Serw-1 was lower one in the most flowering traits. The same performance showed in forage and dry yield t fed^{-1}. Whereas Helali-1 and Giza-6 cultivars were insignificantly different in number of inflorescences plant^{-1}, but both of them were significantly higher than for both cultivar in all trail. Helaly-1 and Giza-6 cultivars were classified as the highest productivity of seed g m^{-2}, as well as fed^{-1} compared with the other cultivars under study. This study has shown that early blooming date has low seed set, but the latest blooming date produce the highest percentage of seed setting under Giza environmental conditions of commercial berseem cultivars. It could be concluded that cultivation of Helaly-1 and Giza-6 cultivars produced the maximum of seed setting in July and produced highest forage and dry yield under Giza environmental conditions. Vital pollen grain ranged from 75% to 90% of third and fourth blooming periods. Temperature (28 - 32^{o}C), relative humidity (45 -55%) and wind speed (1.2- 2 m sec^{-1}) and their interactions with low differences ranges between day and night temperature ^{o}C, soil temperature, may be the best environmental conditions, in Giza, for setting seeds and regulating the movement of pollinators, increase the pollination efficiency and seed yield potential.

Key words: *Berseem Clover, Temperature, Humidity, Wind Speed, Blooming, Seed Set, pollen Grain.*

INTRODUCTION

Egyptian clover *(Trifoliurm alexandrinum* L.) is an annual leguminous forage species well adapted to semi-arid conditions of the Mediterranean areas. Egyptian clover, has played a key role in the development of human health and vitality by providing the animal protein sources (a major food for animals and poultry), which leads to increase the efficiency of performance and production. Ideally, temperature and moisture conditions should be favorable to maintain continuous vigorous growth throughout the growing and seed setting period for maximum seed yields. Dry weather, just prior to and during harvest, is essential for high yields of good quality seed. Most legumes such as alfalfa and clovers require bees for pollination so generally honey bee colonies must be placed in the seed fields to supplement natural bee populations to obtain satisfactory seed yields. Climatic changes, related temperature and humidity changes, may affect the forage yield and quality by decrease growth season, increase water requirements, increase saline soils, decrease protein contents in leaves, decrease number of cutting (forage yield) and accelerate flowering (low pollinator visitor and low seed setting). Seed yield is affected mainly by insect visitation since seed setting in most populations is drastically reduced under insect-free conditions (Said, 1954; Wafa and Ibrahim, 1960; Bakheit, 1989).

An increase in temperature with low humidity predicted to cause recurrent droughts in most of the region. Don Breazeale *et al*, (2008), recorded that warmer temperatures increase tripped flowers and reduce the time of tripped flowers occur and thus the increase in total seed yield. These studies have contributed to greater knowledge about berseem clover seed yield production and the many interrelated factors that ultimately affect yield. Bakheit *et al.* (2009) study the effect of sowing date on fertility traits and yield and reported that the first of October sowing date was the best date of highest number of florets and seeds/head, seed set%, 1000 seed weight and seed yield.

The objective of this study was aimed to determine the effect of different temperature and humidity regimes on seed setting in five berseem cultivars under Giza environmental condition. Furthermore, berseem seed yield can be an important role in Egyptian economic fund, seed lots exported annually from Egypt to other countries particularly in Asia.

MATERIALS AND METHODS

Two field experiments were carried out at Giza Agricultural Research Station during 2008/09 and 2009/10 seasons. Five Miskawi, multi-cut, Egyptian clover cultivars (Giza-6, Sakha-4, Helaly-1, Gemmiza-1 and Serw-1) were sown in dense planting with seed rate 20 kg/fed and three replications in a Randomize Complete Block Design. Each cultivar was sowing on five rows of four meter long and 25 cm apart while cultivars in each replication were separate by 50 cm. Three cuts were taken at 60, 90 and 115 days after sowing for multi-cut cultivars, and then plants were left to produce seeds. Recommended fertilizer and irrigation was applied. 50 plants of each cultivar were evaluated for seed setting inflorescence^{-1} for two growing seasons. Four temperature periods, 1/4 -15/4, 15/4 - 1/5, 1/5 - 15/5 and 15/5 - 1/6, were chosen to study the effect of temperature, humidity and wind speed (m/sec) changes on seed setting per plant, whereas, the period of inflorescence maturity (10-15 day) in clover was applied according to Ghamrawy *et al*., (1965) and (12 -15 day) according to Abd El-Naby, (2009). Open pollinated seed set floret^{-1}%, No. of floret inflorescence^{-1}. No. of inflorescences plant^{-1}, seed set floret^{-1}, No. of seeds floret^{-1}, the weight of 1000 seeds g, the weight of seed yield g m^{-2} and seed yield kg fed^{-1}, were measured as a characters in our study. Some aspects of floral biology were measured to determine environmental effects on time of anthesis dehiscence, the period of pollen viability, the gestation period of tripping and fertilization. Pollen grain from 10 randomly floret Anthers (in each replication) were stained with1-2 drops of Alceto-charmen then examined per slide under a microscope (Olympus BH-2). Vital pollen grains stained red, sterile stained green.

Pollen vitality (%) was calculated as standard visual degree scale from 1:5 according to pollen grains size and shape. Three cuts were evaluated for fresh and dry yield in ton fed^{-1} and total yields of each season and over seasons were analyzed. Statistically analyzed was used SAS software (SAS Inst., 1988), while means were separated using the Duncan, (1955) method.

RESULTS AND DISCUSSION

In season 2008/09 temperature, regimes have seen a steady increasing among the successive blooming dates with the same performance of relative humidity (Table 1). The third blooming, 15/5, date was recorded low wind speed 1.8 (m sec^{-1}) compared with the other dates 2.1 m sec^{-1} of the first and second time and 2.0 m sec^{-1} for the fourth one. Season 2009 /10 recorded an increasing in temperature degrees (^{o}C) and wind speed (m sec^{-1}) among successive blooming dates with varied in relative humidity (R H%) between high and low over blooming dates (57.0, 51.0, 55.0 and 46.0%). Differences were found between temperature, relative humidity, wind speed and day, sunshine duration (hour) and night degree of temperature ^{o}C in different seasons couldn't be explained by the effect of each of them separately, but the effect is an integrated action on seed set (Table 1). The positive interactions over all factors of the activities of pollinators to complete pollination process, while negative interaction leads to the opposite role.

Table 1. Means and average of maximum, minimum and average temperature°C, sunshine duration hour^{-1}, relative humidity (RH%) and wind speed (m sec^{-1}) of four blooming dates among two growing seasons (2008/09 and 2009/10).

Season		Blooming Periods			
		Mid April	First May	Mid May	First June
2008/09	Max. temperature °C	31.1	30.3	32.9	36.6
	Min. temperature °C	16.2	16.4	20.0	22.2
	Temp. average °C	24.4	25.5	27.0	29.6
	Sunshine duration (hour)	12.8	13.3	13.5	13.9
	Relative Humidity%	47.0	44.0	51.0	54.0
	Wind Speed (m sec^{-1})	2.1	2.1	1.8	2.0
2009/10	Max. temperature °C	30.7	29.0	31.3	37.1
	Min. temperature °C	15.4	16.9	18.2	21.3
	Temp. average °C	22.9	23.2	26.2	29.7
	Sunshine duration (hour)	12.8	13.3	13.5	13.9
	Relative Humidity%	57.0	51.0	55.0	46.0
	Wind Speed (m sec^{-1})	0.9	1.1	1.2	1.4
Average	Max. temperature °C	30.9	29.7	32.1	36.9
	Min. temperature °C	15.9	16.7	19.1	21.9
	Temp. average °C	23.7	24.4	26.6	29.7
	Sunshine duration (hour)	12.8	13.3	13.5	13.9
	Relative Humidity%	52.0	47.5	53	50
	Wind Speed (m sec^{-1})	1.5	1.6	1.5	1.7

Source: Meteorological authority, Giza, Egypt.

**Differences between day and night degrees of temperature ranged from 5°C in April, 4.3 to 4.5°C in May and 4.3 °C in June.*

Means of open pollinated seed set in each season was showed in Table 2. Helaly-1 cultivar recorded the highest percentage of seed set at the first season (2008/09) of the first , second and third blooming dates 17.7 , 29.2 and 43.0% followed by the Giza-6 cultivar of the same blooming dates (14.4, 27.9 and 39.5%). Giza-6 cultivar was superior to all cultivars in the fourth blooming date, 29.6^{o}C average of temperature and 54% relative humidity with the highest sunshine duration 13.9, in the first season 59.0 %. Sakha-4 cultivars showed similar results in first May and first June to Helaly-1 and the same performance of Giza-6 cultivar in Mid-May of the first season (2008/09). Serw-1 cultivar showed lowest seed set compared with the other tested cultivars (Table 2).

Table 2. Means of open pollinated seed setting at four blooming dates with different temperature, humidity and wind speed regimes of five Egyptian clover cultivars during (2008/09 and 2009/10.

Cultivars	Blooming Dates							
	Mid April		First May		Mid May		First June	
	08/09	09/10	08/09	09/10	08/09	09/10	08/09	09/10
Giza-6	14.4^{b}	16.9^{a}	27.9^{ab}	28.7^{a}	39.5^{a}	41.0^{a}	59.0^{a}	58.2^{a}
Helaly-1	17.7^{a}	17.1^{a}	29.2^{a}	29.0^{a}	43.0^{a}	42.2^{a}	56.9^{a}	56.3^{ab}
Serw-1	11.1^{c}	11.5^{c}	26.4^{ab}	26.2^{b}	42.4^{a}	40.6^{a}	53.2^{b}	51.0^{c}
Gemmiza-1	12.8^{bc}	12.5^{b}	25.4^{b}	26.9^{b}	34.5^{b}	36.8^{b}	51.7^{b}	54.7^{b}
Sakha-4	11.3^{c}	12.2^{b}	29.2^{a}	29.4^{a}	39.1^{a}	38.5^{ab}	56.4^{a}	54.5^{b}
Mean	13.46	14.04	27.62	28.04	39.7	39.82	55.44	54.94

Means in each column followed by similar letters are not significantly different at 5% level.

Second season 2009/10 showed low temperature and wind speed with high relative humidity in all periods except for the fourth, high temperature with low relative humidity and wind speed (Table 1). Combined analysis over two years in Table (3) indicated high significant differences in both first and third blooming periods (mid-April and mid-May), while there were insignificant differences between cultivars and also between the interaction between years and cultivars. Means of open pollinated seed set at four blooming dates as a combined analysis between cultivars over the two growing seasons were indicated high significant differences between cultivars in two blooming dates only, Mid April and Mid May, this may be related to the increasing in the differences rate between day and night temperature ^{o}C (5 in first April and 4.5 in mid-May) with high relative humidity for the same dates.(Table 3)

In Table 4 data was recorded the same performance of all cultivars, except for Serw-1 cultivar reported lower seed setting in final blooming date (51.0%) compared with of Giza- 6, Helaly-1, Gemmiza-1 and Sakha-4 (58.20, 56.30, 54.70 and 54.50 %, respectively).

Table 3. Combined analysis of Mean squares of open pollinated seed setting at four blooming dates with different temperature, humidity and wind speed regimes of five Egyptian clover cultivars over the two studied seasons.

S.O.V.	d.f.	Blooming Dates			
		Mid April	First May	Mid May	First June
Year	1	0.324	1.764	1.089	5.550
Replication	3	27.366	24.266	10.625	53.770
Cultivars	4	60.677**	15.656	59.464**	54.493
Year* Cultivar	4	3.166	1.064	5.149	10.079
Error	27	10.385	9.526	6.014	29.935
C.V.		23.522	11.050	6.164	9.926

*** high significant differences at $p \leq 0.01$.*

Table 4. Means of open pollinated seed setting in four blooming dates with different temperature, humidity and wind speed regimes of five Egyptian clover cultivars over the two studied seasons.

Cultivars	Blooming Dates			
	Mid April	First May	Mid May	First June
Giza-6	15.27^{ab}	28.30^{a}	40.75^{ab}	58.35^{a}
Helaly-1	17.77^{a}	29.10^{a}	42.48^{a}	56.65^{a}
Serw-1	11.30^{c}	26.80^{a}	41.52^{ab}	51.92^{a}
Gemmiza-1	11.40^{c}	26.17^{a}	35.65^{ab}	53.17^{a}
Sakha-4	12.75^{bc}	29.32^{a}	38.58^{b}	55.58^{a}
Mean	13.70	28. 30	39.78	55.12
Heritability%	94.78	93.20	91.34	81.50

Means in each column followed by similar letters are not significantly different at 5% level.

Helaly-1 Cultivar was demonstrated high seed set, over the two seasons, except for the fourth blooming date 17.77%, 29.10%, 42.48% and 56.65% followed by Giza-6 cultivar was superior seed set of the fourth blooming date 58.35%. In First May Helaly-1 and Sakha-4 cultivars recorded similar performance of seed setting (29.10% and 29.32%). The four blooming dates set seed over the two seasons recorded 13.70% of the first date, 28.30% of the second date, 39.78% of the third date and 55.12% for the fourth date (Table 4).

Higher variation in studied cultivars indicated in each blooming dates due to the differences between environmental factors under study. In the first blooming date (24.60 ^{o}C and 52.00% RH), in the second blooming date (26.40 ^{o}C and 47.50 % RH), in the third date (29.1^{o}C and 53% RH) and in the fourth date (31.4^{o}C and 50% RH) . As the seed-setting period of the former synchronises with the low hot season during April, the development of seed adversely affected, resulting in poor setting and shriveled seeds. Heritability over two seasons indicated 94.78%, 93.20%, 91.34% and 81.50% of the first, second, third and fourth blooming dates, respectively.

Means of the number of inflorescences plant^{-1}, number of florets per inflorescences plant^{-1} and number of seeds florets^{-1} were shown in (Table 5). Analysis of variances of the number of inflorescences plant^{-1} (not presented) recorded high significant differences in the first date, significant differences in the second and third date with no significant differences between cultivars for the fourth date. Significant differences were recorded for number of florets inflorescence^{-1} in the first date with insignificant differences of the three successive dates.

The number of inflorescences plant^{-1}, also, recorded significant changes among blooming periods (Table 5). This disparity is due to the difference in temperature and relative humidity in each period of the study (Table 1). The results recorded in the third and fourth blooming dates for means of the number of inflorescences plant^{-1} was the highest (14.71 and 17.93 respectively), while that in the first blooming time was the lowest one over seasons (5.19). The results recorded for number of flowers inflorescence^{-1} over both seasons was not significantly different for the fourth blooming periods (ranging from 93.30 and 99.50), but the other three blooming periods were significantly different over years with total means 79.97, 82,25 and 92.69 florets inflorescence^{-1} over cultivars. However, Helaly-1 cultivar recorded the highest number of florets inflorescence^{-1} in all blooming periods, which were 93.0, 95.75, 96.0 and 99.5 and also has the largest number of seeds floret^{-1} (16.53, 27.86, 40.78 and 56.37). (Table 5)

The number of inflorescences stem^{-1} is decreased under moisture stress, while temperature during the period from forage removal to full bloom appeared to have the greatest number of inflorescences per stem. Guy *et. al.* (1971) observed that over the 17^{o}C to 27^{o}C temperature rage increase the number of inflorescences stem^{-1} and number of florets inflorescence^{-1} but increasing in temperature over 32^{o}C reduces both of them. This study indicated that despite the increase in temperatures of 32 ^{o}C but the apparent decrease in both relative humidity and wind speed also led to a high amount of seed set, 52.46 seeds over cultivars, in early June. And that might have opened up opportunities to increase pollination by pollinators, especially honey bees.

Table 5: Means of the number of inflorescences plant^{-1}, number of florets inflorescence^{-1}, seed setting floret^{-1} and no. of seeds floret^{-1} over two seasons of five Egyptian clover cultivars under different blooming dates.

Cultivars	No. of inflorescences plant^{-1}				No. of florets inflorescence^{-1}				No. of seeds floret^{-1}			
	Mid April	First May	Mid May	First June	Mid April	First May	Mid May	First June	Mid April	First May	Mid May	First June
Giza-6	6.09 ^{a}	7.86 ^{a}	14.68 ^{b}	18.50 ^{ab}	75.39 ^{b}	81.44 ^{ab}	96.46 ^{a}	96.00	11.51 ^{b}	23.05 ^{b}	39.31 ^{a}	56.02 ^{a}
Helaly-1	6.42 ^{a}	7.92 ^{a}	18.10 ^{a}	20.06 ^{a}	93.00 ^{a}	95.75 ^{a}	96.00 ^{a}	99.50	16.53 ^{a}	27.86 ^{a}	40.78 ^{a}	56.37 ^{a}
Serw-1	4.34 ^{b}	6.32 ^{b}	13.56 ^{b}	16.11 ^{b}	74.06 ^{b}	75.61 ^{b}	94.65 ^{a}	93.10	8.37 ^{c}	20.26 ^{c}	39.30 ^{a}	48.34 ^{c}
Gemmiza-1	4.50 ^{b}	7.61 ^{a}	12.71 ^{b}	17.00 ^{ab}	78.01 ^{b}	79.51 ^{b}	85.65 ^{b}	93.50	8.89 ^{c}	20.81 ^{c}	30.53 ^{c}	49.71 ^{bc}
Sakha-4	4.58 ^{b}	7.67 ^{a}	14.50 ^{b}	18.00 ^{ab}	79.40 ^{b}	78.96 ^{b}	90.70 ^{ab}	93.30	10.12 ^{bc}	23.15 ^{b}	34.99 ^{b}	51.86 ^{b}
Mean	5.19	7.48	14.71	17.93	79.97	82.25	92.69	95.07	11.08	23.03	36.98	52.46

Means in each column followed by similar letters are not significantly different at 5% level.

A result of which will be improve of pollination either through insects and / or through triggering tripping and pollen dehiscence during organs development and growth or while being affected by outer forces i.e. wind movement. Many authors reported that large size of inflorescences and flowers attracted pollinating insects (Geber, 1985 and Eckhart, 1991), and may retain pollinating insects than small flowers (Dudash, 1991 and Conner and Rush, 1996).
Variation between the blooming period and self-seed setting % over seasons ranged from 0.65% to 0.89% for the first, from 2,05% to 2.86 % for the second, from 3.50%to 6.20 % for the third and from 4.24 %to 7.37 for the fourth blooming date (Figure 1).

Larkin and Graumann, (1954), were observed that variation in Auto-seed setting might have resulted from the effect of environmental factors on alfalfa genotypes lacking tight control over agent-mediated tripping. The florets of berseem clover are adapted to pollination by insect. Berseem clover was predominately cross-pollinated but with various degree of self-fertility (Abd El-Naby, 2009). Science the activity of the pollinating insects strongly influenced by prevailing weather conditions during the flowering period; the environment effects such as wind and temperature via insect activities (Viands *et al*. 1988) affect pollination and tripping.

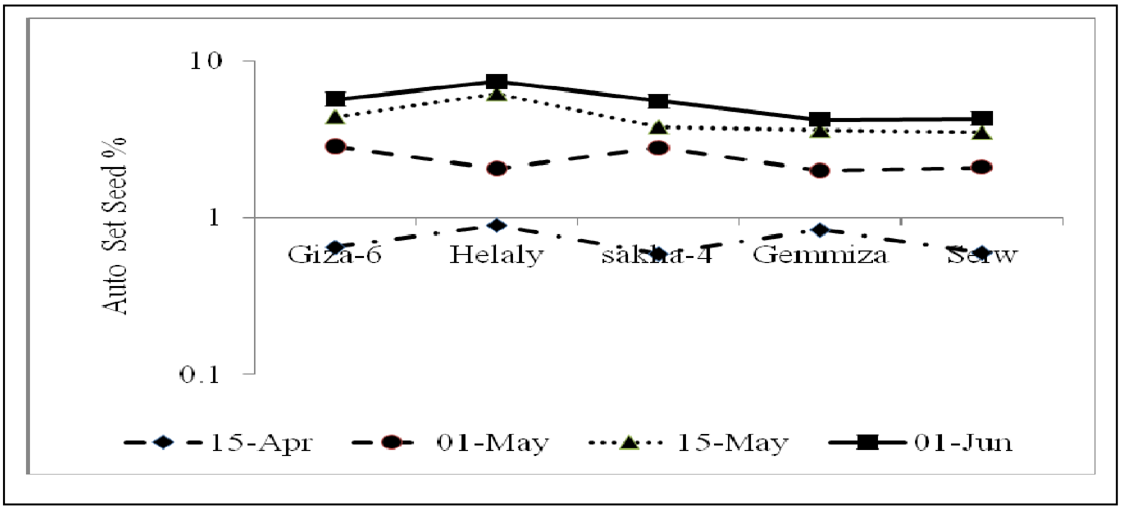

Figure 1. Relationship between auto set seed% and blooming periods of commercial cultivars over two seasons.

Weight of 1000 seeds in g indicated insignificant differences in all blooming periods except for the second period. The four blooming period's means, were recorded 2.60, 2.84, 2.90 and 3.00 g, respectively over the two seasons.

Helaly-1 cultivar, more tolerant to high temperature, indicated high performance over all cultivars with insignificant differences with them for all periods except for the second period (first May) recorded significant differences over the two seasons (Table 6). Helaly-1 cultivar has classified the highest productivity of seed m^{-2} compared with the other cultivars under study. Helaly-1 cultivar recorded (10.26, 21.62, 74.70 and 115.89 g m^{-2}) for the seed yield m^{-2}. The seed weight means g m^{-2} showed high variation through the for blooming periods of environmental conditions and recorded 5.22 , 16.03, 51.96 and 91.32 g m^{-2} over years (Table 6).

Akpan and Bean, (1977), concluded that year to year temperature differences will affect the yield and quality of seed crops of forage grasses. Huyghe *et al*. (2001) and Bolanos-Aguilar *et al.*, (2002), were agree that variation in alfalfa seed yield is primarily due to weather conditions in the year of growing.

Table 6: Means of the weight of 1000 seeds g and seed weight g m^{-2} over two seasons of five Egyptian clover cultivars under different blooming dates.

Cultivars	Weight of 1000 seeds g				Seed weight g m^{-2}			
	Mid April	First May	Mid May	First June	Mid April	First May	Mid May	First June
Giza-6	2.71 ^{a}	2.93^b	3.12^a	2.99^a	6.14^b	17.16^b	58.21^b	100.19^b
Helaly-1	2.99^a	3.03^a	3.13^a	3.17^a	10.26^a	21.62^a	74.70^a	115.89^a
Serw-1	2.34^c	2.62^c	2.68^b	2.86^b	2.75^d	10.85^c	46.18^b	72.01^d
Gemmiza-1	2.59^b	2.91^b	2.81^b	2.94^{ab}	3.11^c	13.82^c	34.63^c	79.79^c
Sakha-4	2.40^{bc}	2.70^c	2.76^b	2.92^b	3.88^c	16.71^b	46.10^b	88.73^c
Mean	2.60	2.84	2.90	3.00	5.228	16.032	51.964	91.322

Means in each column followed by similar letters are not significantly different at 5% level

Analysis of variances of total forage and total dry yield during 2008/09, 2009/10 and over the two seasons indicated high significant differences between cultivars. Means of total forage and total dry yield showed similar highly performance of Helaly-1, Giza-6 and Sakha-4 cultivars over years (51.53, 50.62 and 47.42 t fed^{-1}) for forage yield and (8.25, 8.10 and 7.59 t fed^{-1}) for dry yield, respectively. The same performances of Serw-1 and Gemmiza-1 cultivars ,with insignificant differences were concluded 39.38 and 42.43 and 6.30, 7.04 t fed^{-1} for total forage and dry yields (Table 7).

Interaction between temperature and relative humidity increases the impact of each of them individually on the anthesis dehiscence, the pollen viability, tripping and fertilization as well as wind speed, while the moderate increase of movement and activity of pollinators, thus contributing to the success of the tripping and fertilization. Increasing temperatures speed up the maturation and anthesis dehiscence, while working on the lack of pollen grain viability. Increase the relative humidity on the lack of help speed the germination of pollen within stigma and access to the ovary for fertilization and pollination. (Table 7)

Table 7. Means of total forage and dry yields t fed^{-1} of five commercial cultivars during 2008/09 and 2009/10 seasons and over seasons.

Cultivars	2008/09		2009/10		Over seasons	
	Fresh Yield t fed^{-1}	Dry Yield t fed^{-1}	Fresh Yield t fed^{-1}	Dry Yield t fed^{-1}	Fresh Yield t fed^{-1}	Dry Yield t fed^{-1}
Giza-6	51.10^a	8.18^a	50.13^a	8.23^a	50.62^a	8.10^a
Helaly-1	51.53^a	8.25^a	51.53^a	8.25^a	51.53^a	8.25^a
Serw-1	38.60^b	6. 81^b	39.97^c	6. 93^c	39.38^c	6.30^c
Gemmiza-1	42.80^b	7.01^b	42.27^{bc}	6.96^c	42.43^b	7. 04^b
Sakha-4	48.50^a	7.76^a	46.33^b	7.41^b	47.42^{ab}	7.59^{ab}
Grand Mean	45.71	7.31	46.75	7.37	46.28	7.44

Means in each column followed by similar letters are not significantly different at 5% level.

Berseem clover inflorescence takes about 10 to 15 day from starting bud stage till seed maturity according to number of florets and environmental conditions. In generally increasing in temperature (28 to 32°C), relative humidity (45 to 55%) and wind speed (1.2 to 2m sec^{-1}) accelerate the anthesis and anther dehiscence with the suitable environment for the growth of pollen tubes, reduce the bubbles in the stigma that hinder the process of the pollen penetration of stigma cells. Moderate wind speeds enable pollinators to complete the process of pollination and collecting the largest number of pollen grains to reduce competition on the moisture. Increasing in temperature and relative humidity reduce the viability of pollen grain.

Figure (2-a) pointed that little pollen grain with incomplete roundedness shape, figure (2-b) recorded about 50% vital and rounded pollen grain, figures2-c and 2-d recorded vital pollen grain ranged from 75% to 90% of third and fourth blooming periods. Moderate temperature, differences between day and night degrees of temperature ^{o}C, relative humidity%, wind speed m sec^{-1} and sunshine duration hour^{-1} help pollinator to increase pollination efficiency of cross-pollinated crops and enhances the ability of both cross or self- pollinated crops on natural self-seed set and then increase seed yield potential. Increases of wind speed with the extremely high temperature in the harvest season, lead to the disintegration of the seed and reduce seed yield per unite area.

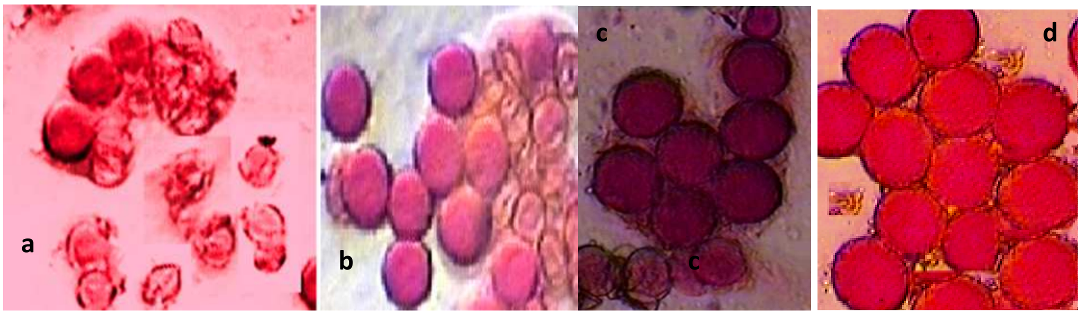

Figure2. Pollen grain viability: a) first, b) second, c) third and D) fourth blooming periods.

CONCLUSSION

It can reasonably be concluded that the results of this study showed that despite the high temperatures but the relative humidity and wind speed can be considered as a contributing factor to increase or lack of immediate effect on berseem seed set. Selection for early high seed set population. Selection to the families of early maturity and high seed in the contract may be suitable for cultivation in Upper Egypt, where high temperatures and can also be selections to the families of late maturity period of stay and the highest proportion of contract high of seeds can be grown in the delta and parts of Middle Egypt. Temperature (28 - 32^{o}C), relative humidity (45 -55%), wind speed (1.2- 2 m sec^{-1}), low differences between day-night temperature ^{o}C(soil temperature) and tall sunshine duration hour^{-1} and their interactions may be the best environmental conditions, in Giza, for setting seeds and regulating the movement of pollinators, increase the pollination efficiency and increase seed yield. Therefore, this study needs more effort and more from other studies might be interpreted precisely this role. Breeding programs for the Egyptian clover must include harvesting date for the selection of superior forage yield under the environmental conditions of each climatic zone in Egypt.

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