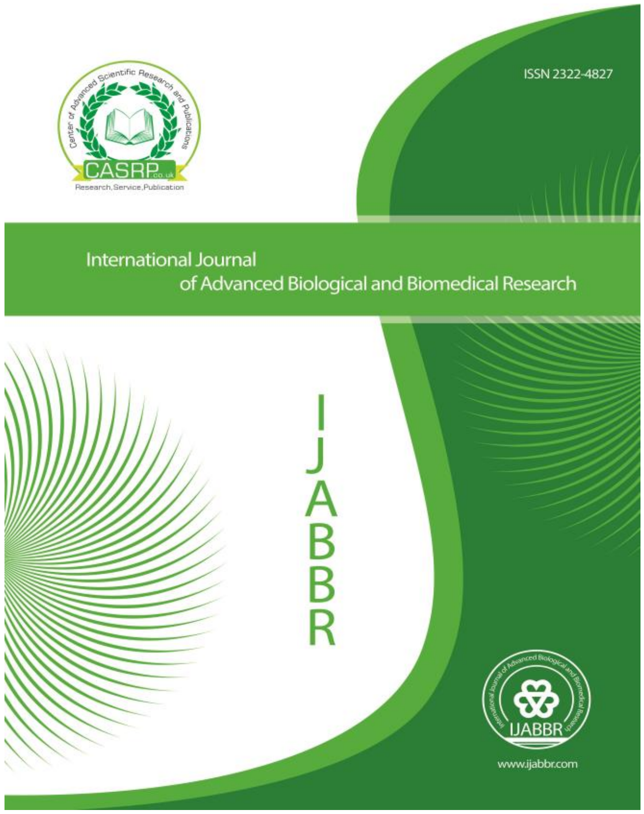
ISSN 2322-4827
CASRP
International Journal
of Advanced Biological and Biomedical Research
IJABBR
www.ijabbr.com

Available online at www.casrp.co.uk/journals

CASRP PUBLISHER

International Journal of Advanced Biological and Biomedical Research 4(3) (2016) 296–304

Original Article

Open Access

# Evaluation growth analysis and grain yield of sunflower cultivars under sowing date in dry condition

**Mohsen Javaheri***

*Department of Agronomy, Qorveh Branch, Islamic Azad University, Qorveh, Iran.*

## Abstract

Sunflower is one of the most important edible oil that growth of annual crops, it is grown over a widely area and is considered a crop adapted to an every environmental conditions, in order to study growth analysis of sunflower under sowing date and cultivars in dry condition a farm experiment was conducted a split plot arranged in a complete randomized block design with three replications in the Dry Research Station. Main plots consist of four level sowing dates with ten-day intervals from (March 30 - April 30) and subplots consist of three cultivars: Record, Zarya and Azargol. In different sowing dates observed that sunflower plants had slow growth in the primary stage afterwards had a quick growth, so in second sowing date sunflower plants had a quick growth with received 1220 growing degree days. Among different cultivars, Record, cultivar had highest crop growth rates and relative growth rate. Record cultivar with 125 days had highest growth duration and Zarya with 122 days had lowest growth duration so sowing date and cultivar had a significant effect on grain yield, grain yield reduced with delayed in sowing date and Record had a highest grain yield. Results of evaluation total dry matter (TDM) showed that Record cultivar had highest total dry matter also, among different cultivars statistical significant different was observed thus delay in sowing date reduced oil yield and highest oil yield was obtained from Record cultivar.



**Keywords:** Crop growth rate, Dry condition, Grain yield, Growth analysis, Sunflower.

***Corresponding author:** Department of Agronomy, Qorveh Branch, Islamic Azad University, Qorveh, Iran.



Received 19 November 2016 | Accepted 18 December 2016 | Available online 25 December 2016

iThenticate screening 22 November 2016 | English editing 15 December 2016 | Quality control 21 December 2016

## 1. Introduction

Sunflower is one of the edible oil plants that have a main role and the ability to resist drought, so sunflower have non suffusion fatty acid (January, 2003). The Sunflower growth in middle zone, but it can achieve well under different weather and soil situation this fitness makes it facility for the crop to be ripe under a diversity of area (Nodp, 2005). Yield specifications are modified by environmental effects (as seasonal differences) in leaf area improvement and invention usage during planting in spring (Agele, 2003). So Hassan et al. (1999) reported that leaf area as well as crop advance, increased gently with the time of the crop, period a point in the middle and reduce so at progressive growth stages, so similarly, Jose et al. (2004) concluded that leaf area and leaf area index increased in the spring due to increased leaf area length and intercepted solar radiation. Crop growth rate (CGR) increases up to the assurance growth stage due to maximum intercepted solar radiation, additional which mutual shadow of leaves increases, thus affecting the light impression into the base of the canopy and ultimately causing decrease in CGR. Reduction of CGR due to lack of energetic lives and transposition of photosynthetic to sexual parts (Hassan et al., 1997). Crop growth rate, leaf area advance and achene yield were recorded in the plotssown in spring. Similarly, Hendrickson et al. (2004) found an excess in CGR with increase in temperature. Simplifying of the growing cycle decreases the amount of radiation intercepted during the growing season and thus total dry matter at harvest (Vega and hall, 2002).

Mohammad azharmunir et al. (2007) concluded that several composers of organic and inorganic fertilizers significantly affected the crop growth rate (CGR) and net contraction rate (NAR) of sunflower during both years. Higher temperature during 0-45 DAS shortened the emergent time, head initiation, leaf area continuity and crop growth duration which decreased the seed yield of the monsoon sown crop; whenever maximum vigor, plant growth, crop growth rate, leaf area improvement and achene yield were recorded in the plotssown in spring (Caliskan et al., 2002). Nayyar et al. (2007) reported that plants had higher values of crop growth rate, net assimilation rate, leaf area permanence in warmer conditions as compared to lower values obtained in cold conditions. Addition in NAR with the addition in temperature, but highest temperature caused a little decrease in assimilation and biomass, which were maximum an average temperature (Dennis et al., 2006). Our objectives of this scholarship were to appraise the effect of growth analysis on grain yield and determine the best sowing date for received to highest yield.

## 2. Materials and methods

This examination was accomplished at Dryland Research Station that located in the west of Iran in 2015, The experimental site is located at of 36˚ 11′ N latitude and 46˚ 19′ E longitude with an altitude of 1800 m above sea level. Treatments ordered as a split plot in randomized complete block design with three replications Initial plots consist of four levels, sowing date with ten-day intervals from (March 30 - April 30) and subplots consist of three cultivars: Record, Zarya and Azargol. Each subplot consist of 10 lines with 8m long, and planted with a 75 cm distance between rows and 35 cm distance between plants on rows thus with 3.8 plants density in each $m^2$. Land of the examen was plowed in the fall and disked in spring. With precision of the annual precipitation mean and soil test results 60 kg N, 45 kg p and 45 kg k was consumed in one hectare.

**Table 1**
Soil moisture percent.

| | Soil moisture percent in different depth | | | |
|---|---|---|---|---|
| **Sowing dates** | **0-20 Cm** | **20-40 Cm** | **40-60 Cm** | **60-80 Cm** |
| First sowing date | 3 | 5 | 7 | 10 |
| Second sowing date | 10 | 12 | 13 | 15 |
| Third sowing date | 9 | 10 | 13 | 14 |
| Fourth sowing date | 15 | 20 | 22 | 26 |

Evaluated of dry matter was done in 7 processes with 14 days interval, in each sampling 3 plants was selected of second, third and fourth line of each plot, then samples conducted to oven for 48 hour with 72c temperature, with recorded 6c base temperature (Aguirrezabal et al., 2003).

**Table 2**
Result of physiochemical test soil.

| Electrical conductivity | pH | Total nitrogen | Organic carbon | Clay | Silt | Sand | Absorption potassium | Absorption phosphorus |
|---|---|---|---|---|---|---|---|---|
| | | ds/m | | | (Percent) | | mg.g | |
| 0.41 | 7.6 | 0.07 | 0.64 | 36.5 | 33.5 | 30 | 361 | 8.2 |

GDD (Growing degree days) accounted with relation number:

$$GDD = \frac{Tmax + Tmin}{2} - Tb$$

For an accounting of physiological index variables of total dry weight (TDW) and leaf area index (LAI) are followed from quadratic, for a reduction variance of correlation relation to means to changing to Ln result showed: relations number 2 and 3.

$$\mathrm{LnTDW} = \mathrm{a} + \mathrm{b} + ch^2$$
$$\mathrm{LnLAI} = \mathrm{a}' + \mathrm{b}' += ch^2$$

Relative growth rate (RGR) resulted with differential of relation number 2:
Relation 4

$$\mathrm{LnTDW} = \mathrm{a} + \mathrm{b} + ch^2$$
$$\mathrm{LnLAI} = \mathrm{a}' + \mathrm{b}' += ch^2$$

And crop growth rate was accounted with fifth relation:

$$CGR = \frac{d(TDM)}{dh} = (a + 2ch)e^{(a+bh+ch)^2}$$

In this relation a, b, $a^1$, e, $b^1$, were coefficient of regression equations and h was thermal unit (GDD).

Result of coefficient appointment should be more than of 1.5 and Durbin Watsonmore than about 90 percent. Evaluated of Phenological traits were done in during of experiment that consist of, flowering duration, reproductive development duration, grain filling period, growth duration and dates to vegetative stage so in the end of the growth season in each plot with sampling from 3 $m^2$, 1000- seed weight, harvest index, productivity effort, grain yield, oil percent, oil yield, were evaluated, and oil content was evaluated with Sukselehapparatus with the Select a-Jet 2 model. Analysis variance was done with SAS 2003, so comparison means done with the Duncans test in (5%) and growth indices were evaluated with Statgraphics plus 2, The objective of growth analysis is the definition of the addition in dry matter referred to a sufficient basis for photosynthetically active tissue leaf area and yield.

## 3. Results and discussion

Evaluate of dry matter, relative growth rate and crop growth rate with growth degree days showed that sowing dates and cultivars and their interactions had followed from quadratic, significant level, coefficient of determination and Durbin Watson are coming in (Table 3).

Results showed that plants in first sowing date had slow growth until to receive 347 GDD, Tout concurrent with germination stage and in the end of flowering stage with received 526 GDD had quick growth until to received 1313 GDD, so after that in physiological maturity stage with received 1516 GDD dry matter of plants reduced (Fig 1), thus plants in each stage with received sunradiation had various responses, in second sowing date plants with toreceived 444, and 1220 GDD had slow and quick growth respectively, that concurrent with flowering stage, after that dry matter of plants decreased with received 1420 GDD and starting yellowish of leaves, thus plants in flowering stage had highest dry matter until to starting physiological maturity, so in third sowing dateplants had slow growth until to received 363 GDD, and had quick growth until to received 1176 GDD that concurrent with flowering stage after that dry matter of plants decreased with received 1565 GDD and leaves of plants was yellowish that concurrent with physiological maturity stage, in fourth sowing dateplants had slow and quick growth to received 294 and 1264 GDD respectively that concurrent with flowering stage after that dry matter of plants decreased with received 1454 GDD and leaves of plants was yellowish and result showed that second sowing date had highest dry matter with 99.5 $g.m^2$ and lowest dry matter resulted from fourth sowing date, this result showed that in sunflower cultivars plants in flowering stage had highest dry matter until to starting physiological maturity and after that synthesis of dry matter was equal with consume of that.

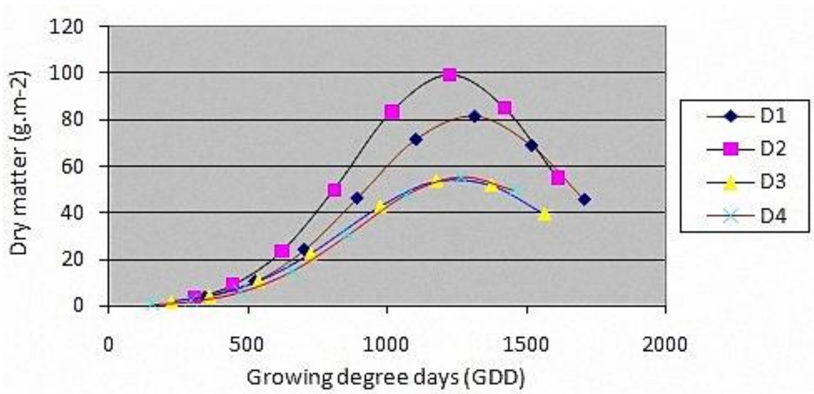


**Fig. 1.** Relation between dry matter and growing degree days in different sowing date.

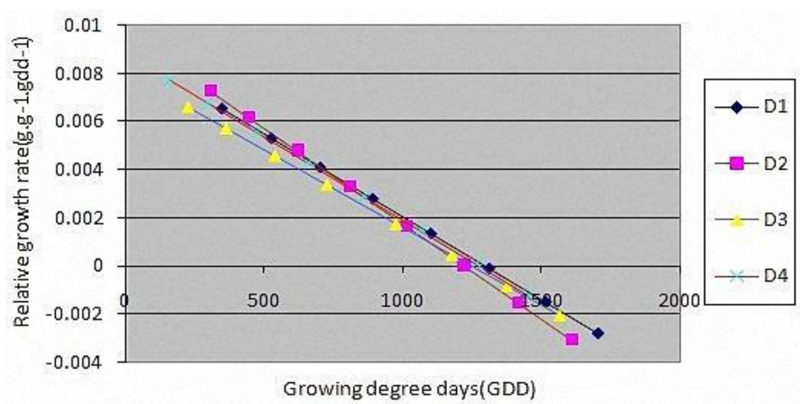


**Fig. 2.** Relation between relative growth rate and growing degree days in different sowing date.

Evaluate of relative growth rate showed that plants in first sowing date had slow growth until to receive 347 GDD, and highest relative growth rate with 0.006 g.g. Day resulted from plants, that concurrent with the germination stage so relative growth rate of plants decreased with received 1102 GDD, Dabre and Bang. (1985) reported that decrease of RGR estimate from early growth stages to final stages, in Second sowing date plants had slow growth until to received 444 GDD, and in the end of germination stage plants had highest relative growth rate with 0.007 g.g. day after that in 75 percent of flowering stage, relative growth rate of plants decreased until to received 1220 GDD. So plants with received 1420 GDD had negative relative growth rate that concurrent with end of flowering and starting yellowish of leaves, in third sowing date plants in the end of germination stage with 0.006 g.g. day had highest relative growth and relative growth rate of plants decreased until to received 1176 GDD.

After that leaves of plants was yellowish with received 1375 GDD and had a negative relative growth rate, in fourth sowing date plants in plants had highest relative growth rate with 0.007 g.g. day in germination stage that resulted from B157 GDD, after that plants with received 1454 GDD had a negative relative growth rate that concurrent with end of flowering stage and starting yellowish of leaves (Fig 2).

**Table 3**
Coefficient appointment and durbin Watson.

| Treatment | Formula | D-WR2 |
|---|---|---|
| First sowing date | LOG TDM=-1.40693+(0.0089574×GDD)-(0.00000345349×(GDD^2)) | 2.7396.76** |
| Second sowing date | LOG TDM=-1.3619+(0.0097395×GDD)-(0.0000398718×(GDD^2)) | 2.6197.30** |
| Third sowing date LOG | TDM=-1.0499+(0.00808473×GDD)-(0.00000323501×(GDD^2)) | 3.5098.97** |
| Fourth sowing date LOG | TDM=-1.61738+(0.00883283×GDD)-(0.00000346294×(GDD^2)) | 2.6398.94** |
| Record cultivar LOG | TDM=-1.4216+(0.010359×GDD)-(0.00000450729×GDD^2)) | 3.5898.55* |
| Zarya cultivar LOG | TDM=-1.20978+(0.00861074×GDD)-(0.00000359294×GDD^2)) | 1.3096** |
| Azargoal cultivar LOG | TDM=-0.988571+(0.00861103×GDD)-(0.00000351887(GDD^2)) | 2.6597.68** |

*Significantly of model at $P \leq 0.05$ eventuality level, ** Significantly of model at $P \leq 0.01$ eventuality level.

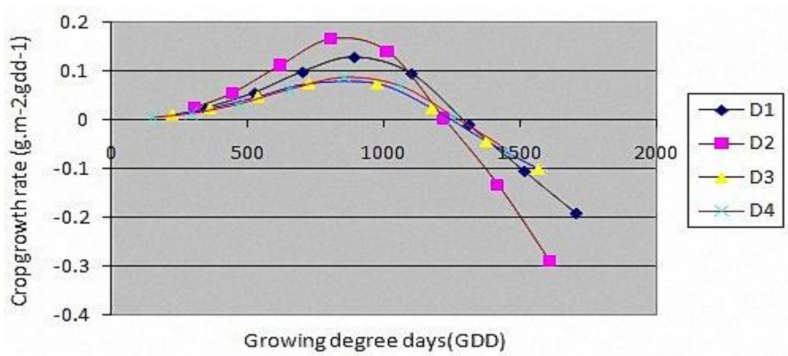


**Fig. 3.** Relation between crop growth rate and growing degree days in different sowing date.

Evaluate of crop growth rate in first sowing date showed that crop growth rate of the plant increased until to receive 892 GDD that concurrent with budding stage and had highest crop growth rate with 0.12 g.m2. day, after that stage at the end of flowering stage crop growth rate of plants decreased and had a negative crop growth rate. Decrease of CGR at later growth stages might have been due to loss of effective leaves and transposition of photosynthates to sexual parts (Hassan et al., 1997), in second sowing date crop growth rate of plants increased until received to 807 GDD that concurrent with buding stage and in that stage plants had highest crop growth rate with 0.16 g.m2. day socrop growth rate of plants decreased and was negative, in third sowing date crop growth rate of plants increased until to received 725 GDD and highest crop growth rate with 0.07 g.m$^2$ was resulted, after that stage crop growth rate of plants decreased until to end of flowering stage plants had negative crop growth rate (Fig 3). Shuaib Kaleem et al. (2010) introduced that CGR abundance up to definite growth stage due to maximum intercepted solar irradiance above which reciprocal shading of leaves increases, thus affecting the light influence to the base of the canopy and ultimately causing decay in CGR, so crop growth rate of plants in fourth planting increased until to received 858 GDD that concurrent with buding stage of plants and had highest crop growth rate with 0.06 g.m2. day, after that stage crop growth rate of plants decreased and until to end of flowering stage had negative crop growth rate.

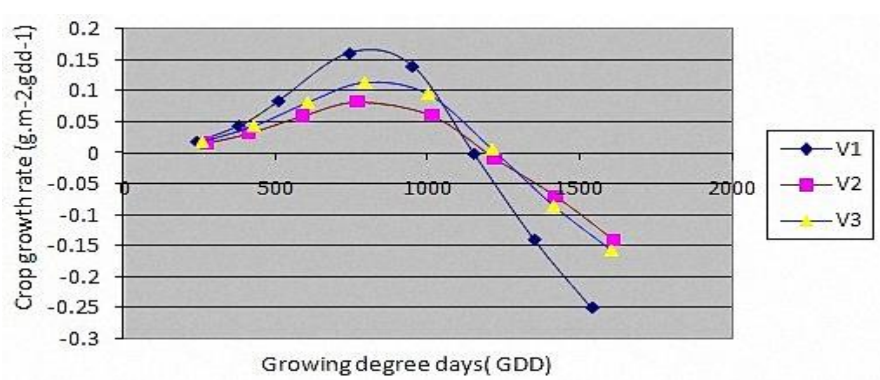


**Fig. 4.** Relation between crop growth rate and growing degree days in different cultivars.

Evaluated showed that in buding stage crop growth rate of plants with received to 742 GDD was increased and highest crop growth rate with 0.16 g.m2. day was resulted, after that satge crop growth of plants decreased until in the end of flowering stage had negative crop growth rate, in Azargol cultivar crop growth rate of plants increased until to received 792 GDD that concurrent with 75 percent flowering of plants and highest crop growth rate with 0.18 g.m2. day was resulted, after that stage crop growth rate of plant decreased until in the end of flowering stage plants had negative crop growth rate, Caliskan et al. (2002) reported that higher temperature during 0-45 DAS shortened the emergence period, head initiation leaf area duration and crop growth continuity which diminished the seed yield of the monsoon sown crop while maximum vigor, plant growth, crop growth rate, leaf area advancement and achene yield were recorded in the plots improvement and achene yield were recorded in the plotssown in spring. Similarly, Nayyar et al. (2007) reported preferable values of crop growth rate, net assimilation rate, leaf area continuity in a warmer position as compared to lower values obtained in cold qualification so in Zarya cultivar results showed that crop growth rate of plants increased until to received 770 GDD that concurrent with 75 percent flowering and had highest crop growth rate with 0.08 g.m2. day, after that stage in the end of flowering plants had negative crop growth rate (Fig 4).

### 3.1. Grain filling period

The result showed that the second sowing date with 12 days had longest grain filling period and fourth sowing date with 11 days had shortest grain filling period so record with 12 days and Zarya with 10 days had longest and shortest grain filling period (Table 5), so Z. Flagella et al. (2002) concluded that whenever the early planting date may have derived advantage of the low temperature of the early status of seed improvement, the shortest temperature recorded in the last phase of grain filling in the irrigated treatment may not be accountable for the shortest oleic/linoleic acid ratio observed and Tremolie`res et al. (1982) reported that temperature may have a great result on sunflower oil specs of grain filling. Lengthening of the grain filling phase at a cooler time observed in the irrigated treatment and the forecast of the planting date, resulted in lower mean temperature during grain filling in both years (Flagella et al., 2002).

### 3.2. Growth duration

The efficacy of variance analysis showed that growth length was significantly specious by sowing date (Table 4), cultivar and interplay between planting date and cultivar, so first sowing date with 127 days and fourth planting date with 123 days had the longest and shortest growth continuity respectively, so record with 125 days had the longest growth length and Zarya with 122 days had shortest growth duration (Table 5), javahery and rokhzadi (2011) reported that the effect of cultivar on growth stages was significant, the longest and the shortest periods of developmental stages were recorded by Azargol and Lacomka cultivars respectively.

### 3.3. 1000- seed weight

The result of variance analysis showed that 1000-seed weight was significantly affected by cultivar treatment and Azagoal cultivar with 46 g had highest 1000-seed weight and Zarya with 31 g had lowest 1000-seed weight (Table 5), so Ravishankar et al. (1991) reported reduction in sunflower seed yield, 100-seed weight and total dry matter under early water stress.

### 3.4. Productivity effort

The result of variance analysis showed that Productivity effort was significantly affected by cultivar, so Zarya cultivar with 62 percent had higher Productivity effort and record cultivar with 53 percent had lowest Productivity effort (Table 5).

### 3.5. Harvest index

The result showed that Azargoal cultivar with 44 percent had a higher harvest index and record with 36 percent had the lowest (Table 5), so Bange et al. (1997) concluded that evolutions in both biomass collection and harvest index were definitive in establishing yield reductions associated with late planting dates in a subtropical area, Biomass collection was mostly influenced by the amount of intercepted radiation rather than by radiation use efficiency. Harvest index is used by plant breeders to describe the collection and redistribution of assimilates to attain final grain yield (Michael et al., 1998). So reductions in harvest index were associated with a shortening in the grain filling period and a diminution in the daily rate of harvest index increase (Bang et al., 1998).

### 3.6. Grain yield

The result of variance analysis showed seed yield was significantly affected by cultivr and highest grain yield resulted from second sowing date with 511kg/ha, so Azargoal with 504 kg/ha had a higher grain yield that showed that the maximum harvest index in the plant caused the highest grain yield (Table 5), Bange et al. (1997) presented that use this physiological frame to study the impress of planting date (S) on sunflower yield achievement, then Ablardo (2002) concluded that planting date affected oil-corrected seed yield. Lower yields associated with late planting would be due to the unfavorable environmental positions during the early growth period (Abelardo J. de la Vega and Antonio J. Hall., 2002). Shafiullah et al. (2001) reported that the sunflower crop should be harvested 35 days after flower initiation and 25 days after flower achievement to get better seed yield, so perfect flowering and maturity had a significant role in enhancing the seed yield (Khan, 2001).

**Table 4**
Results of variance analysis traits.

| | | Mean square | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S.O.V** | **df** | **Grain filling period** | **1000- seed weight (g)** | **Harvest index (%)** | **Productivity effort (%)** | **Grain yield (Kg/ha)** | **Oil percent (%)** | **Growth duration (day)** |
| Replication | 2 | 1.36$^{ns}$ | 51.262$^{ns}$ | 70.779$^{ns}$ | 69.843$^{ns}$ | 23825.261$^{ns}$ | 5.88$^{ns}$ | 2.778$^{ns}$ |
| Sowing date | 3 | 0.333$^{ns}$ | 80.203$^{ns}$ | 235.248$^{ns}$ | 4.980$^{ns}$ | 700247.813$^{*}$ | 486.1$^{**}$ | 307.509$^{*}$ |
| Error | 6 | 3.250$^{ns}$ | 46.573$^{ns}$ | 102.196$^{ns}$ | 37.703 | 125462.081 | 4.020 | 37.370$^{ns}$ |
| Cultivar | 2 | 4.861$^{ns}$ | 861.92$^{**}$ | 102.196$^{ns}$ | 349.143$^{**}$ | 162093.661$^{**}$ | 12.60 | 134.36$^{**}$ |
| Sowing date* Cultivar | 6 | 0.528$^{ns}$ | 36.553$^{ns}$ | 58.759$^{ns}$ | 42.251$^{ns}$ | 21749.623$^{ns}$ | 0.896$^{**}$ | 307.509$^{*}$ |
| Error | 16 | 1.194ns | 24.417$^{ns}$ | 36.276 | 50.606 | 18404.055 | 4.442 | 68.806$^{ns}$ |
| C V(%) | | 8.90 | 12.78 | 16.49 | 12.13 | 21.75 | 4.03 | 2.08 |

ns, Non significant; *, Significant at the 5% of probability level (P< 0:05); **, Significant at the 1% of probability level (P < 0:01).

### 3.7. Oil percent

The result showed that record with 51 percent and Azargoal with 49 percent had highest and lowest oil percent numerous studies have shown that oil environment. Biomass collection was mostly impression istic yield in sunflower is decreased when normal spring planting by the amount of disconnect radiation rather dates are postponed in both temperate (Robinson, 1970), so Jasso de Rodriguez et al. (2002) formerly reported that the oil content of sunflower seed analyzed at grain filling and production showed a little decline from grain filling to harvest.

**Table 5**
Mean values of yield and yield component as impression by sowing date and cultivar factors.

| **Sowing date** | **Cultivar** | **Grain filling period (day)** | **1000-seed weight(g)** | **Harvest index(%)** | **Productivity effort(%)** | **Grain yield Kg/ha** | **Oil percent (%)** | **Growth duration (day)** |
|---|---|---|---|---|---|---|---|---|
| First sowing date | | 12.33a | 37.46a | 37.76a | 59.16a | 485.3a | 51.39a | 127.6a |
| Second sowing date | | 12.58a | 35.41a | 41.23a | 57.75a | 511.1a | 51.17a | 125.6a |
| Third sowing date | | 12a | 33.52a | 33.13a | 59.34a | 318.1a | 51.45a | 124a |
| Fourth sowing date | | 11.44b | 41.28a | 34.75a | 61.57a | 395.0a | 50.56a | 123.3a |
| | Record | 12.58a | 31.51b | 36.86b | 53.12b | 483.6a | 51.80a | 125.6a |
| | Zarya | 10.3a | 31.12b | 40.69ab | 62.58a | 293.9b | 51.67a | 122.6b |
| | Azargoal | 12a | 46.41a | 44.06a | 57.41ab | 504.7a | 49.96a | 124a |

Various types within each group of a column showed significant differences at $P \le 0.05$ according to Duncan's multiple range test.

## 4. Conclusion

Our results showed that sowing date and cultivar treatments had a significant impression on yield and oil percent of canola and yield of plants was increased, and crop growth rate and relative growth rate of plants increased with the growth of sunflower, that showed the importance of growth a factor of plants.

## Acknowledgments

We are thankful for the present from the Faculty Research of Qorveh Branch, Islamic Azad University, Qorveh Iran and Seed and Plant Improvement Institute, Karaj, Iran.

## References

Abelardo, J., de la, Vega, Antonio, J., Hall, 2002. Effects of sowing date, genotype, and their interactions on sunflower yield. Crop. Sci., 42, 1191-1201.

Agele, S.O., 2003. Sunflower responses to weather variations in rainyand dry cropping seasons in a tropical rain forest zone. IJOB, 32, 17-33.

Aguirrezabal, L.A.N., Lavaud, Y., Dosio, G.A.A., Izquierdo, N.G., Andrade, F.H., Gonza´ lez, L.M., 2003. Intercepted solar radiation during seed filling determines sunflower weight per seed and oil concentration. Crop. Sci., 43, 152-161.

Bange, M.P., Hammer, G.L., Rickert, K.G., 1997. Environmental control of potential yield of sunflower in the subtropics. Aust. J. Agr. Res., 48, 231-240.

Bange, M.P., Hammer, G.L., Rickert, K.G., 1998. Temperatureand sowing date affect the linear increase of sunflower harvest index. Agron. J., 90, 324-328.

Caliskan, M.E., Gngel, E., Cagar, A., Mert, M., 2002. Effect of sowing dateson phonological development, yield and oil content of sunflower (*Helianthus annuus*L.) in a Mediterranean type environment. Ind. J. Agron., 43, 427-432.

Dabre, W.M., Bang, S.R., 1985. Physiological analysis of yield variation in sunflower (Helianthus annuus L.) genotypes. PKV Res. J., 9, 19–22 (Field Crop Abst., 39, 8861; 1986).

Dennis, S.M., Rahman, L., Baker, J., Reddy, V.R., Fleisher, D., Quebedeaux, B., 2006. Whole plant photosynthesis, development and carbonpartitioning in potato as a function of tempertature. Agron. J., 98, 1195-1203.

Hassan, F.U., Leitch, M.H., Ahmad, S., 1997. Growth rhythms of linseed *(Linumusitatissimum*L.) Pak. J. Bot., 29, 119-123.

Hassan, F.U., Leitch, M.H., Ahmad, S., 1999. Dry matter partitioning in Linseed (*Linumusitatissimum*L*.).* J. Agron. Crop. Sci., 183(2), 213-216.

Hendrickson, I., Bell, M.G., Wood, J.T., Chow, W.S., Furbank, R.T., 2004. Low temperature effects on photosynthesis and growth of grape vine. Plant. Cell. Environ., 27, 795-809.

January, M., 2003. Genetic analysis of heritable traits in sunflower (*Helianthus annuus*L). PhD. Agr. Thesis, Department of Plant Breeding and Genetics, NWFP Agric. Univ., Peshawar-Pakistan, 215.

Jasso, de Rodriguez, D., Phillips, B.S., Rodriguez-Garcia, R., Angulo-Sanchez, J.L., 2002. Grain yield and fatty acid composition of sunflower seed for cultivars developed under dry land conditionsp. 139-142. In: J. Janick and A. Whipkey (eds.). Trends in New Crops and New Uses. ASHS Press, Alexandria, VA, USA.

Javahery, M., Rokhzadi, A., 2011. Effects of biofertilizer application on phenology and growth of sunflower (Helianthus annuus L.) Cultivars. J. Basic. Appl. Sci. Res., 1(11), 2336-2338.

Jose, F.C.B., Carralho, M.D., Basch, G., 2004. Response of sunflower (*Helianthus annuus*L.) to sowing date and plant density under.

Khan, A., 2001. Yield performance, heritability and interrelationship in some quantitative traits in sunflower Helia, 24, 35-40.

Michael, P., Bange, Graeme, L., Hammer, Kenneth, G., Rickert, 1998. Temperature and sowing date affect the linear increase of sunflower harvest index. Agron. J., 90, 324-328.

Mohammadi, k., Hedari, G., Javaheri, M., Rokzadi, A., Karimi Nezhad, M.T., Sohrabi, Y., Talbi, R., 2012. Fertilization affects the agronomic traits of high oleic sunflower hybrid in different tillage system.

Mohammadi, k., Hedari, H., Javaheri, M., Karimi Nezhad, M.T., 2012. Soil microbial response to tillage systems and fertilization in a sunflower rhizosphere. J. Agron. Soil. Sci., 1(11).

Muhammad, Z.M., Muhammad, A.M., Muhammad, F.S., 2007. Impactof integration and nitrogen application on growth yeild and quality of spring planted sunflower (Helianthus annuus L.). Pak. J. Bot., 39(2), 441-449.

Nayyar, H., Kaur, G., Kumar, S., Upadhyaya, H.D., 2007. Low temperature effects during seed filling on chickpea genotypes: Probing mechanism affecting seed reserves and yield. J. Agron. Crop. Sci., 193, 334-336.

NODP, 2005. Annual report on oil seed crops. Ministry of Food, Agriculture and Livestock, Govt. Pak. Islamabad.

Ravishankar, K.V., Shankar, R.U., Ravishakar, H.M., Kumarand, M.U., Prasad, T.G., 1991. Development of drought tolerant sunflower for semiarid tracts of India: Duration of the genotypes influence their performance under imposed moisture stress. Helia, 14, 77-85.

Robinson, R.G., 1970. Sunflower date of sowing and chemical compo- sition at various growth stages. Agron. J., 62, 665-666.

Rotunno, Z.F.T., Tarantino, E., Di Caterina, R., De Caro, A., 2002. Changes in seed yield and oil fatty acid composition of high oleic sunflower (Helianthus annuus L.) hybrids in relation to the sowing date and the water regime. Eur. J. Agron., 17(2002), 221–230.

Shafiullah, M.A., Khan Baitullah, M.A., Rana, B.R., Khan, Ozair, C.A., 2001. Effect of dessicant application and time of harvest on yield and oil quality of sunflower (*Helianthus annuus*L.). Helia, 24, 105-114.

Shuaib Kaleem, F-ul, Hassan, A., Razzaq, A., Manaf, Saleem, A., 2010. Growth rhythms in sunflower (*Helianthus annuus*L.) in response to environmental disparity. Afr. J. Biotechnol., 9(15), 2242-2251.

Tre,´molie`res, A., Dubacq, J.P., Drapier, D., 1982. Unsaturated fatty acids in maturing seeds of sunflower and rape: Regulation by temperature and light intensity. Phytochem., 21, 1-45.

Vega, Hall, 2004. Analysis of growth and yield of maize, sunflower and soybean grown at Balcarce, Argentina. Field. Crop. Res., 41, 1-12.

**How to cite this article:** Javaheri, M., 2016. Evaluation growth analysis and grain yield of sunflower cultivars under sowing date in dry condition. International Journal of Advanced Biological and Biomedical Research, 4(3), 296-304.