

The effects of planting date on quantitative and qualitative yield of sunflower in Iran and the world: A Meta analysis ¹

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ABSTRACT

The science of meta-analysis provides a comprehensive summary of a set of researches whose results are more stable. Meta-analysis study of the planting date effects on sunflower grain yield quality and quantity were very important in obtaining of perception results and improving of the economical yield. In this study, using meta-analysis, we want to investigate the effects of planting date on grain yield (GY), number of seeds per head (NS/H) and head diameter (HD) using 40 articles published in Iran and the world (between 1995 and 2018). According to the results, the correlation coefficient except for GY ($R=0.2462$), NS/H ($R=0.2462$) was not significant for HD trait. According to the table of average traits, the highest amount of GY (5173 kg. ha^{-1}), NS/H (1818.35), HD (23.9 cm) was, in basis of Julian days (JD) with planting date 1-170 JD range. Highest GY in the range of sowing date 80-170 JD, highest NS/H under 1-80 JD, highest HD in 17-180 JD, the highest of grain oil percentage (GOP) (52.16%) in 171-262 JD and the highest

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1000-seed weight (TSW) (82.11 g) was observed in the treatment of 177-387 JD. According to the results of regression, except for TGW and GOP, other traits showed a negative slope by changing the planting date. Correlation coefficient was significant for GY ($R=0.2462$) and NS/H ($R=0.364$). Based on the intensity model of the effect of sowing date on NS/H, GY and TSW under 1-80 JD, the SOP in the range of 176-387 JD and HD in the range of 81-1701 JD were significant. According to the results of bias in the experiment based on funnel diagram, due to the large range of planting date, positive and negative effects of planting date on traits were observed. Based on the accumulation diagram and review of each study, the general results of meta-analysis show it based on the accumulation diagram and review of each study, the general results of meta-analysis show that the best spring planting time identified under mid-May to mid-June (80-170 JD) and under subtropical to tropical regions from mid-February to mid-March (1-80 JD). In these 25 studies, considering the results of meta-regression no negative correlation was seen in the traits of the number of seeds per head (NS/H) and the grain yield (GY), but for other traits no correlation was seen. On the other hand the results of the accumulation chart also showed that the minimum and the maximum effect size were related to the studies that in addition to the cultivation date had studied the cultivar and cultivation methods including density, so it is recommended that meta-analysis be done on the other factors.

Keywords: Planting date, Meta-analysis, grain oil percentage, , Seed yield, Sunflower.

Introduction

Sunflower is one of the most important oilseeds that has a strategical role in oil supplying in the country. Sunflower is cultivated in a wide range of months of the year and due to the difference in cultivar characteristics compared to the planting date in order to adapt the important physiological stages of growth, it is necessary to study the effect of planting date on important traits (De lavega et al., 2002).

Climate differences have different effects on plant growth and development, in other words, it regulates the temperature and humidity of plant growth and development stages. Geographical and morphological diversity with the habit of diverse growth in tolerance to high and low temperatures is a sign of optimal adaptation of the sunflower plant (Khalifa et al., 2000). Every year, many studies are conducted on the effects of different planting dates on the quantitative and qualitative traits of sunflower oil. Existence of different soil, climate and crop management conditions often do not show the same GY and biomass (B). For example, sometimes planting date delays have negative and positive effects on GY. Therefore, most researchers are looking for valid results based on scientific principles to adjust their management plans to achieve the desired performance. Since planting date is one of the most important factors in yield production and the results of research on different planting dates in Iran and over the world on the characteristics of sunflower oil are contradictory, so a comprehensive study that can provide reliable results with more data to reach a final conclusion, seems necessary. The purpose of this study is to summarize the effects of planting date and in fact different temperature changes in important phenological stages of plant growth using meta-analysis of yield and yield components of sunflower seeds and oil in Iran and the world.

MATERIAS AND METHODS

Search Strategy

Data were obtained from long-term studies (1972-2019) on yield and yield component and percentage of oil in grain sunflower in Iran and some other countries were obtained from refereed journals and peer-reviewed conference proceedings through online searches. Our search was comprehensive including the following keywords: sunflower, date of plant, seed yield, meta-analysis, and percentage of grain oil. And our combinations: date of planting (0-80, 81-170, 171-262, 263-387 in basis Julian day (JD) range. We collected information on date of planting, altitude, location of experiment, agronomic management as reported by the primary authors.

Data Preparation and Descriptive Statistics

Data required for the meta-analysis were in the form of treatment mean (X), its standard deviation (SD) and the number of replicates (n) mentioned in the experimental design. Several authors presented statistical data in different formats such as standard error (SE) and coefficient of variation (CV %). These forms were converted to standard deviation (SD) using the following equations: $SD = \frac{1}{4} SE$. To overcome these challenges, our searches were carried out online in order to get results from some of the world. We identified the factors in our analysis such the 1000-grain weight (TGW), the number of grain per head (NG/H), the grain oil percentage (SOP), the height of the plants (HP), head diameter (HD), and the grain yield (GY) input which could affect the effect sizes and employed the random effects model. In this research different agricultural studies published in authentic academic journals, information and quotation databases of Islamic world, Jahad Daneshgahi, and mag Iran have been used, as well as conferences, scientific reply of research centers, thesis, and articles presented on Google Scholar.Cabi. Scopus. After compiling articles, the ones which could be used in meta-analysis were separated and encoded 26 articles were chosen among 40 articles under study, and processed by meta-analysis. These groups were included in. (0-80, 81-170, 171-262, 263-387 JD range). Then the following important parameters were extracted separately from articles: By using meta-analysis, the data gathered was analyzed and the graphs were drawn. The complete description of the statistical calculation method of meta-analyses is introduced by Hedges et al., 1999. The first step of the meta-analysis is the calculation of average standard deviation of control treatment and experimental treatments under palnt date scenario.

$$d = \frac{\bar{X}_t - \bar{X}_c}{S_p} \times J$$

Which is called (d) : (Hedges et al., 1999).

Therefore, for every 36 independent experiment which are surveyed in this meta-analysis an amount of (d) according to Eq1 calculated. It must be mentioned that the effects of the planting date were calculated separately.

In which X_u and X_t are the averages of control treatments and planting date consequitively, S_p is combined standard deviation of averages, and J is the correction coefficient for the declination of the averages' criterion. The amounts of J and S_p were calculated from equations 2 and 3 consecutively.

$$S_p = \sqrt{\frac{df_c(S_c^2) + df_t(S_t^2)}{df_c + df_t}} \quad \text{(Hedges et al., 1999).}$$

In which S_c and S_t are average standard deviation of the treatment an planting date d treatment, df_c and df_t are the degree of voluntary control and planting date treatment. If the amounts of the standard deviation of the averages are not mentioned in the articles, we can calculate the amount of S_p according to mean squared error (MSE) which is present in the tables of variance analysis of articles.

$$S_p = \sqrt{\left(\frac{n_c + n_t - 2}{n_c + n_t}\right)MSE} \quad \text{4: (Hedges et al., 1999).}$$

In which n_c and n_t are the number of repetitions of control and treatment.

No doubt all the experiments do not enjoy the same degree of precision. Therefore, it is necessary to measure the precision of each experiment and then synchronize them according to the effect size. To do this the variance of the effect size for each experiment (V_d) was calculated.

$$V_d = \left[\frac{n_c + n_t}{n_c \times n_t}\right] + \left[\frac{d^2}{2n(n_c + n_t)}\right] \quad \text{5: (Hedges et al., 1999).}$$

The opposite of this variance is the weight related to that experiment, so each experiment which has a smaller variance, will be heavier.

Finally, a total effect size (d) is calculated which it is in fact the standardized variation between control and planting date treatments for all the experiments surveyed.

$$6: d^* = \frac{\sum w_i d_i}{\sum w_i} \text{ (Hedges et al., 1999).}$$

Standard deviation is calculated by equation 7.

$$7: S_{d^*} = \sqrt{\frac{1}{\sum w_i}} \text{ (Hedges et al., 1999).}$$

The last stage of meta-analysis is meaningfulness experience of d. If you know S_d you can calculate confidence interval of d. If this confidence interval overlaps zero, then the size of the synchronized cumulative effect (d). Will not be meaningful and is different from control treatment, otherwise the difference between treatment and control will be significantly more than zero. All the calculations and drawing of graphs was done by excel. Meta-analysis allows quantitative analyses of experimental results reported by other authors and the estimation of effect sizes (Borenstein et al., 2009). The analysis increases the statistical power available to test hypotheses and differences in response between treatments under different environments (Borenstein et al., 2009). The effect size found in each individual study can be considered an independent estimate of the underlying true effect size, subject to random variation. All studies contribute to the overall estimate of the treatment effect whether the result of each study is statistically significant or not. Data from studies with more precise measurements are given more weight, so they have a greater influence on the overall estimate. However, meta-analysis has potential weaknesses due to publication bias and other biases that may be introduced in the process of locating, selecting and combining studies. Publication bias is the tendency on the part of investigators, reviewers and editors to submit or accept manuscripts for publication based on the direction or strength of the study findings.

Meta-analysis

There are several metrics that have been thoroughly examined for use in meta-analysis. We chose the two methods that are most widely used in ecology: Hedges' d, a standardized difference-based method, and the log response ratio, lnR, a transformed ratio-based method (Eq.1) estimates the standardized mean difference in a manner similar to original effect size measurement, and is the most widely accepted measure of effect size used in the social sciences (Hedges and Olkin, 1985). $d = [(Y_e - Y_c)/s] J(m)$ where Y_e and Y_c are the means of the treatment (e) and control (c) groups, s is the pooled standard deviation, and $J(m)$ is a correction factor to remove small sample bias.

The difference between the mean of the treatment group (Y_e) and the mean of the control group (Y_c) is divided by the pooled standard deviation s, providing effect size, a dimensionless statistic. The variance of Hedges' d permits the calculation of confidence intervals around the effect size. Equation 2 is the variance of Hedges' d, $\text{Variance of } d = s^2 (d) = [(n_c + n_e)/n_c n_e] + d^2/2(n_c + n_e)$ (2) where n_c and n_e are the total number of samples ($\sum n_{ij}$) in the control and treatment group, respectively (Hedges and Olkin, 1985). Equations 3 and 4 are for the pooled standard deviation and correction factor, respectively: $s = [(n_e - 1)(s_e)^2 + (n_c - 1)(s_c)^2] / (n_e + n_c - 2)$ where s_e and s_c are the standard deviations of the individual samples, and $J(m) = 1 - (3 / (4m - 1))$ where $m \approx n_c + n_e - 2$. There are potential problems with Hedges' d pointed out that d is sensitive to the differences in sample standard deviations, rather than the actual strength of the process. For example, in two studies measuring the effect of different predators on the same prey, one predator may appear to have a larger effect size, but in reality d is larger because the studies compiled for that predator

had smaller s values than studies compiled for the other. Log response ratio although no single metric of effect size is optimal for all cases, the use of the log response ratio and its variance (Eq. 5 and 6) is currently favored in the meta-analyses of ecological data (Hedges et al., 1999). $\ln R = \ln (Y_e/Y_c)$ Variance of $\ln R = [(se)^2/n_e (Y_e)^2] + [(sc)^2/n_c (Y_c)^2]$ where the notation is consistent with that used for Hedges’ d. The log response ratio estimates the proportional change between the treatment and control groups (Rosenberg et al., 2000), thus allowing the fuel reduction effect to be derived from the back-transformed log response ratio. Hedges et al. (1999) presented the statistical properties of the log response ratio and exemplified its appropriate usage in meta-analysis. The log response ratio can only be used for data that can be expressed as a ratio, and where the denominator (mean of the control) is not zero or opposite of the overall effect.

Statistical Analysis

In the first step of the analysis, the test of homogeneity as the amount of p-value in different characteristics was more than 5 % null hypothesis is not rejected (table 1). Since the study surveys are different, there will definitely be differences in experiments, there for statistical measurement is not a reason for the heteogenetity of studies, as a result, according to the studied data, assortment was done (tables 2-5). In the second step the between-studies variance was calculated the between-group homogeneity analysis was conducted. Planting of date was considered as a categorical variable and was coded in four levels JD range (1–80, 81–170, 171-262, 262-387) the results of the assortment showed that the dispersion of the coefficinnt of changes in some traits of the TGW, NG/H, GOP, HD and PH was high (tables 2-5), therefore to continuation of meta–analysis seems necessary.

Table 1: homogeneity analysis

Traits	df	d	p-valve
Grain yield (kg. ha ⁻¹)	25	-1.52	0.3749
Plant height (cm)	19	-0.53	0.4652
Number of seed per head	18	-0.75	0.4457
Grain oil (%)	22	0.07	0.4947
Head diameter (cm)	22	-0.25	0.4861
1000-grain weight (g)	21	-0.41	0.4695

Table 2: mean trails of sunflower and homogeneity analysis (1-80-day plant after January)

Traits	Date Planting (Max)	Date Planting (Min)	cv (%)	Means of control	Means of treatment	df	d	p-valve
Grain yield (kg.ha ⁻¹)	4882.58	316.2	3.7	2811.872	3109.016	5	3.42	0.0162*
Plant height (cm)	210.33	137.6	2.2	173.95	163.85	2	1.61	0.1712
Number of grain per head	1818.25	940.9	19.2	1422.1452	1380.32	4	1.26	0.2026
Grain oil (%)	49.57	29.9	29.1	40.51	38.47	4	-1.62	0.1470
Head diameter (cm)	18.93	10.6	16.07	14.91	16.91	4	2.3	0.1418
1000-grain weight (g)	60.96	41.93	1.39	48.56	53.79	4	2.28	0.0957

Table 3: Mean traits and homogeneity analysis (81-170 JD)

Traits	Planting date (Max)	Planting date (Min)	cv. %	Means of control	Means of treatment	df	d	p-value
Grain yield (kg.ha ⁻¹)	5173	811.1	6.68	2964.3536	2426.1655	9	-2.86	0.0804
Plant height (cm)	205.5	123.1	27.4	167.501	154.428	7	-1.27	0.3324
Number of grain/head	1773	4.4	22.6	1017.07	901.99	7	-1.15	0.3369
Grain oil (%)	48.3	25.8	4.48	41.28	39.75	9	-1.08	0.3326
Head diameter (cm)	23.9	9.73	4.39	15.215	12.865	2	-2.96	0.0725
1000-grain weight (g)	76.84	19.34	2.75	54.047	50.502	7	-0.52	0.4192

Table 4: Mean traits and homogeneity analysis (171-262 JD range)

Traits	Planting date (Max)	Planting date (Min)	cv. (%)	Means of control	Means of treatment	df	d	p-value
Grain yield (kg.ha ⁻¹)	4414.3	216.05	11.38	2735.1758	2113.46	12	-1.48	0.3044
Plant height (cm)	166.7	112.5	17.51	147.126	135.43	8	-0.65	0.4244
Grain number/head	12.1	337.8	7.8	892.85	813.37	9	-0.99	0.3807
Grain oil (%)	52.16	21.1	14.8	40.054	40.1	3	1.46	0.1771
Head diameter (cm)	20.73	4.92	7.84	14.99	15.23	13	-0.03	0.4974
1000-Grain weight (g)	76	36	33.13	57.85	54.1	10	-0.28	0.4531

Table 5: Mean traits and homogeneity analysis (263-387JD)

Traits	Planting date (Max)	Planting date (Min)	cv. (%)	Means of control	Means of treatment	df	d	p-value
Grain yield (kg.ha ⁻¹)	2500	403.2	3	1946.16	2056.81	6	0.02	0.4964
Plant height (cm)	184.1	117.1	2.56	163.67	161.19	7	0.02	0.49692
Grain number/head	935	565.6	0.95	750.3	746.19	2	-0.22	0.4545
Grain oil (%)	51	32	1.97	40.29	42.41	5	0.59	0.3930
Head diameter (cm)	18.4	10.8	6.57	15.42	14.28	5	-0.3	0.45
1000-Grain weight (g)	82.11	31	6.54	62.10	53.24	4	-0.5	0.4135

Effect Sizes

There was no change in weighted mean differences in plant height (PH), therefore planting date had no positive effect on PH compared with control (Fig.1). The results of the intensity of the effect of PH showed that this trait was not affected by planting dates and was not significant in any of the planting dates (Fig.1). In the intensity chart, the effect of number of seeds per head (NS/H) was significantly affected by the range of planting date 1-80 JD range. The intensity of the effect of this trait in the range of planting date 80-170 JD, despite the observed changes, but was not statistically significant (Fig.2). According to the intensity chart, the diameter of the head (HD) was significantly affected by the range of planting date 170-181 JD. (Fig.3). The intensity of grain yield was significantly affected by the range of planting date 1-80 days JD (Fig.4) in the graph, the intensity of the effect of 1000-grain weight (TGW) was significant under the influence of the range of planting date 1-80 JD. But in other domains of planting date, no significant increase was observed (Fig.5). The intensity of the effect was significant in the range of sowing date 263-387 on the percentage of grain oil (GOP) (Fig.6).

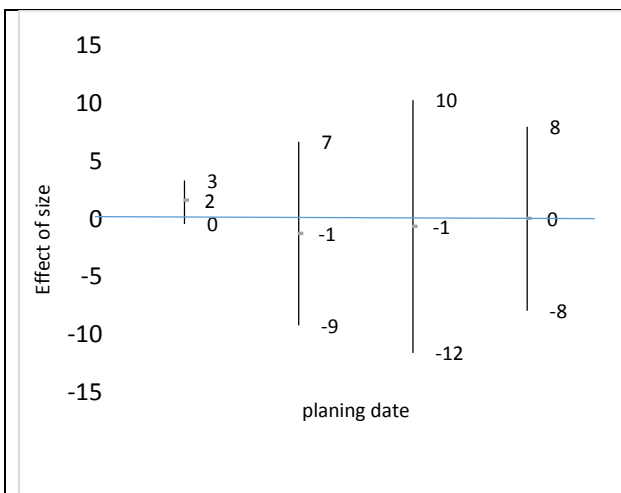


Fig. 1- Comparison of different planting dates on PH. Error bars represent 95% confidence intervals.

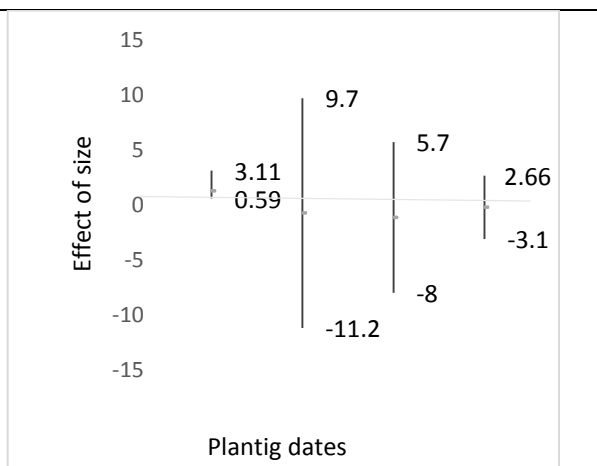


Fig. 2- Comparison of different planting dates on GN/H. Error bars represent 95% confidence intervals.

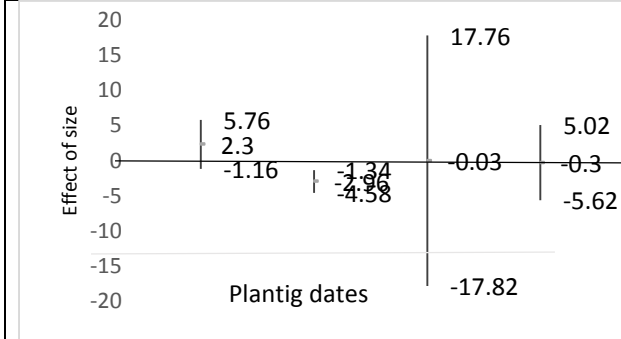


Fig. 3- Comparison of different planting dates on HD. Error bars represent 95% confidence intervals.



Fig. 4- Comparison of different planting dates on GY. Error bars represent 95% confidence intervals.

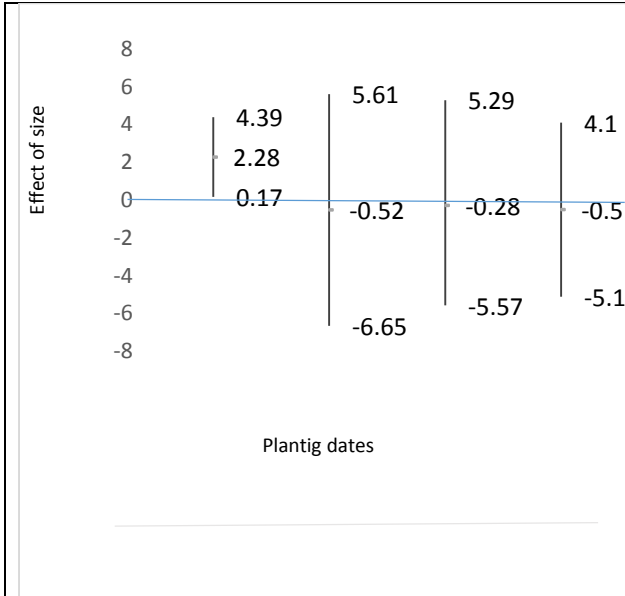


Fig. 5- Comparison of different planting dates on TGW. Error bars represent 95% confidence intervals.

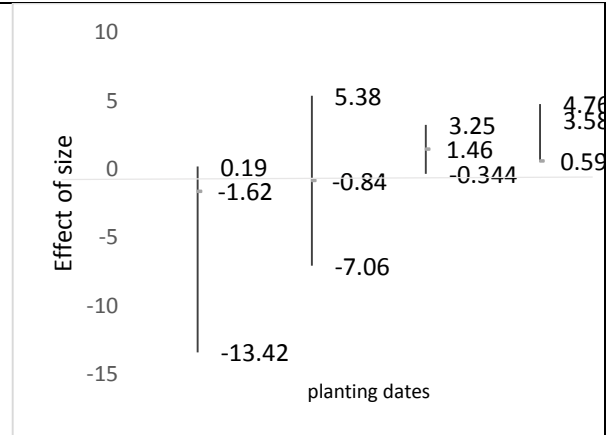


Fig 6: Comparison of different planting dates on GOP. Error bars represent 95% confidence intervals.

Vertical lines are the confidence interval size of weighted cumulative effect.

Meta-regression

Correlation coefficient was not significant, except for GY (R=0.2462) (Fig.7) and NG/H (R=0.364) (8) among other traits, so mentioning these coefficients in the diagrams has been avoided. According to the regression diagram of TGW trait (Fig.9). By changing the planting date, an increasing trend can be seen in this trait. In the regression diagram, the trend of changes in GOP trait under the influence of planting date was fixed (Fig.10). From the meta-analysis presented in Figures 3, 4, 5 and 6, it seems that the response to important economic traits of sunflower oil relate to the range of changes in planting dates is different. Giving the process of trait changes except for TGW and GOP, other traits had a negative slope under the influence of planting date, which shows the negative effect of planting date on these traits (Fig. 7-12).

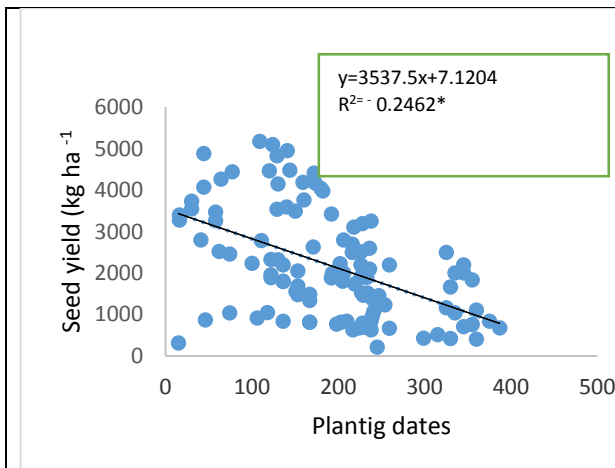


Fig. 7- Response of GY to planting dates (p-value= 0.3749, N = 110)

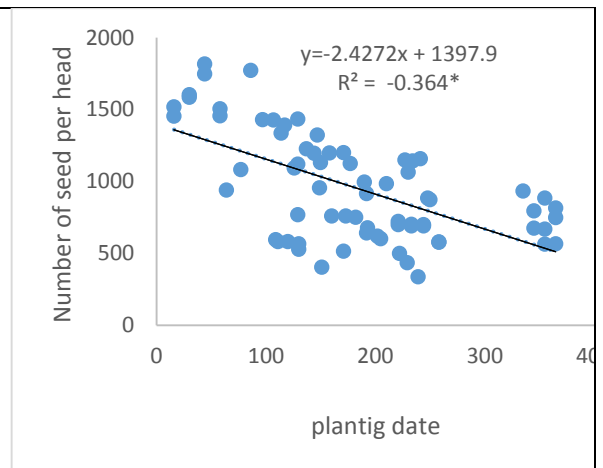
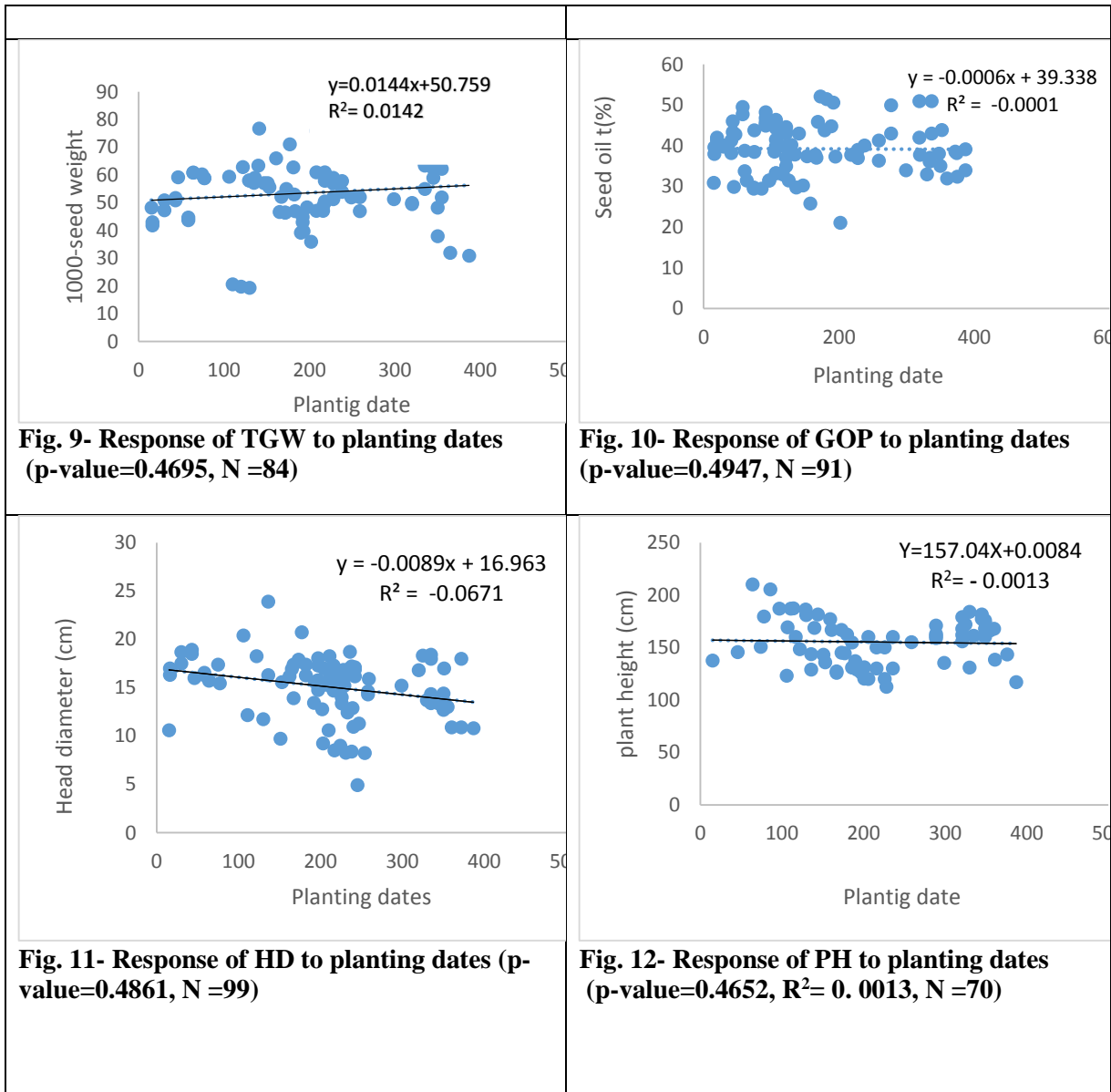


Fig. 8- Response of NG/H to planting dates (p-value=0.4457, N =70)



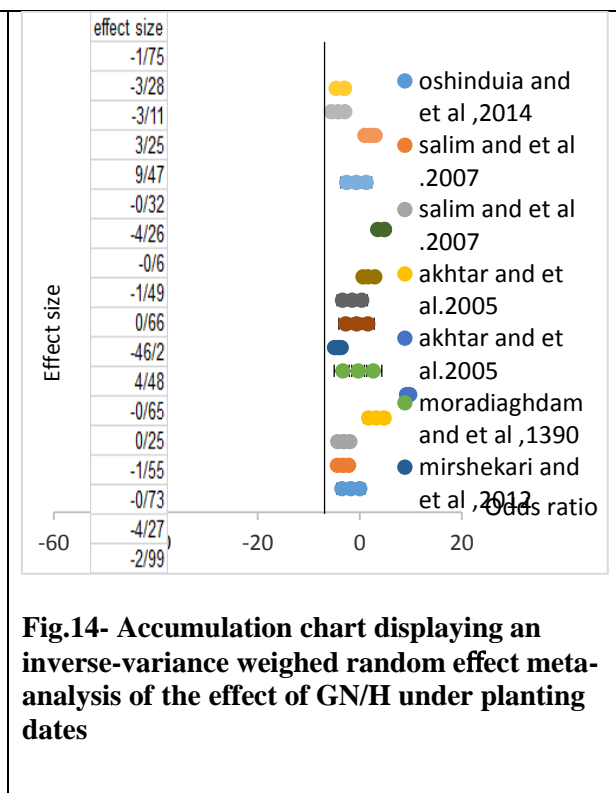
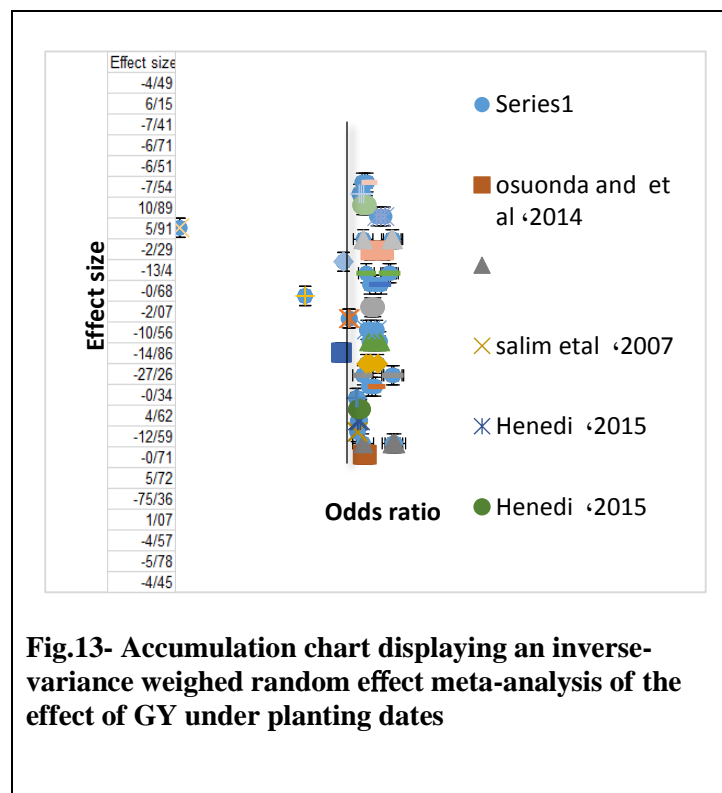
Accumulation diagrams

With the mean weight of articles and 95% confidence interval -1.14 (23.55, -25.83) for equal grain yield, it was shown that the highest additive effect of planting date (+6.15 with increase 800 kg) to the study Ahmad et al. (2015), and had the least negative effect of reduction (-75.36 with increase 250 kg) according to the study of qadir et al . (2007) among 25 studies, 21 studies had a positive charge and 4 articles had a negative charge (Fig.13). were placed out of funnel, it can be showed according the validity of the funnel diagrams 9 and 4 that they had a lower reference rate.

In the accumulation diagram for the GN/H according to the mean effect size and 95% confidence interval -0.75 (28.66, -30.16) in the head also the most positive incremental effect of planting date (+4.48) to study haerinejad et al. (2010) and the least negative reduction effect -46.2) was related to the study of qadir et al. (2007). Out of 18 articles, 17 articles had a positive charge and 1 article had a negative charge (Fig. 14).

Had a low validity and the funnel1 and 24 of the funnel diagrams showed that they were out of reference studies.

According to the results of the accumulation diagram of 22 studies out of 40 studies for TGW, mean effect size and 95% confidence interval -2.22 (19.9, -24.34) The least negative effect of planting date (-15.71 with increase 6 g) to study Mazaheri laghab et al. (2011) and The highest positive effect (9.76 with increase 6 g) and the lowest confidence interval of the study Salim et al. (2015), among 22 articles, 16 articles had a positive charge and 6 articles had a negative charge. (Fig. 15). According to the accumulation diagram of grain oil, mean effect size and 95% confidence interval 0.07 (26.51, -26.37), highest positive incremental effect (+16.09), date of planting to study Salim et al. (2015) and lowest negative effect of planting date (-10.61) belonged to the study Gheorghe and Elena. (2012), among 22, 18 articles have a positive charge and 4 articles have a negative charge (Fig.16). HD trait with mean effect size and confidence interval of -0.32 (55.68, -56.32) 95% had the highest incremental effect of planting date (+6.98) and the lowest confidence interval in the study Akhtar et al. (2005) and the lowest negative effect of planting date (-4.45) belonged to the study Duta. (2011) Among 24 studies, 10 articles had a positive charge and 14 articles had a negative charge (Fig.17). For PH trait, mean effect size and 95% confidence interval -0.51 (36.03, -37.05) the least decreasing effect of planting date (-8.78 lowest confidence interval belonged to the study of mirshekari et al .2012 (1995) highest incremental effect of planting date (+1.26) belonged to the study of Esechie (1995). Out of 200 studies, 16 articles had a positive charge and 4 articles had a negative charge (Fig. 18).



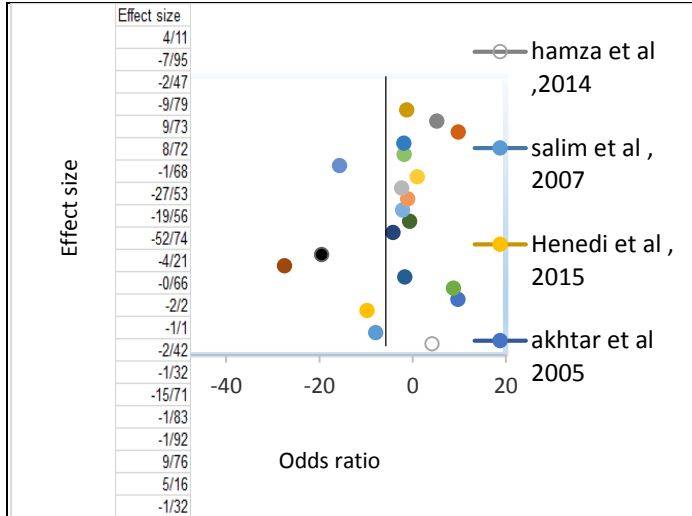


Fig 15- Accumulation chart displaying an inverse-variance weighed random effect meta-analysis of the effect of TGW under planting dates

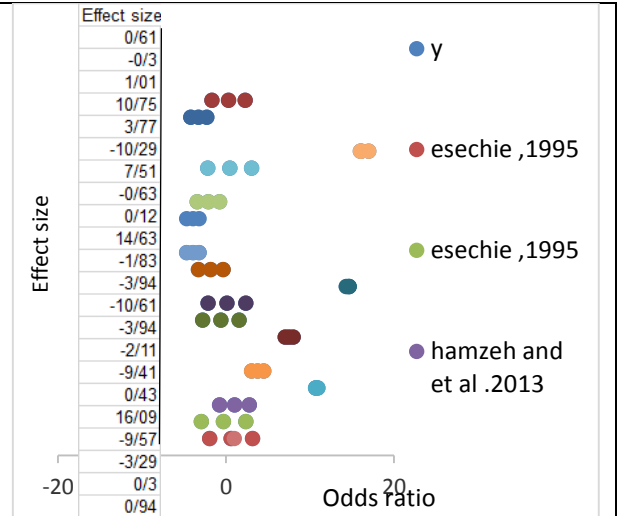
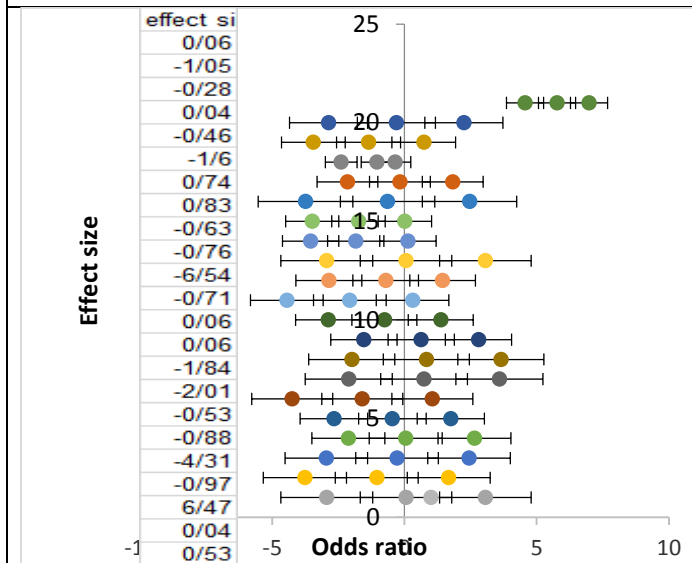


Fig 16- Accumulation chart displaying an inverse-variance weighed random effect meta-analysis of the effect of GOP under planting dates



Fi.17 - Accumulation chart displaying an inverse-variance weightd random effect meta-analysis of the effect HD under planting dates

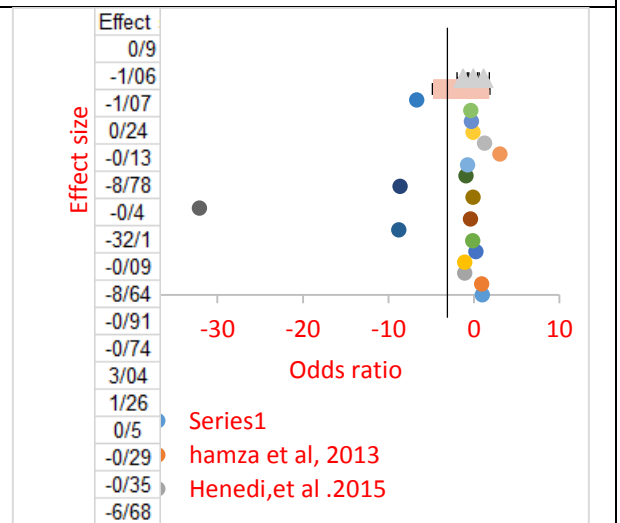


Fig 18 - Accumulation chart displaying an inverse-variance weighed random effect meta-analysis of the effect of PH under planting dates

Bias

By the test, we can observe that the symmetry hypothesis is rejected. It cannot be excluded that there was a certain publication bias within the results. In order to find out whether there was a publication bias in the meta-analysis “funnel plots” were used to detect a possible publication and location bias in this study we didnt have access to the authors and it was too time consuming .we could not gather the articles which

had not been published in valid journal .on the other hand,as some of the resources had been published for a short time ,we didn,t have access ti the details of the studies.the reason why the diagrams are asymmetrical in different characteristics is that most of the articles had a low effect size.there were few articles with high effect size.our meta-analysis was based on local and foreign studies ,so we had to use the studies published in scientific reseach journals and reliable scientific conferences. Funnel diagram of GY of 22 articles, 1 non-funnel article, 6 articles on the right side of the middle line which shows the positive effect of planting date on grain yield and 14 articles on the left side of the middle line which showed the negative effect of planting date on it has GY studies in the middle level of the funnel have relative symmetry and most studies are in the middle part of the funnel (Fig.19). Funnel diagram of GN/H out of 18 articles, 1 article was placed outside the funnel 3 suspicious articles with 5 articles on the right side of the funnel 12 articles on the left side of the article on the left side of the midline which indicates the negative effect of planting date on the GN/H (Fig.20). The diagram also does not have symmetry the funnel diagram of the TGW trait of 21 articles, 6 articles on the right and 14 articles on the left of the middle line were shown. Studies in the funnel base have relative symmetry (Fig.21) in the funnel diagram, the percentage of GOP out of 22 articles, 14 articles to the right of the midline and 6 articles to the left of the midline (Fig.22). Funnel diagram of HD trait with 24 articles, 1 article outside the funnel and 10 articles on the right side of the article and 7 articles on the left side of the middle line of the chart (Fig.23). Funnel diagram of PH trait with 18 articles, only one article was placed outside the funnel line which is not statistically significant, 5 articles were on the right side of the midline and 8 articles were on the left side of the midline (Fig.24)

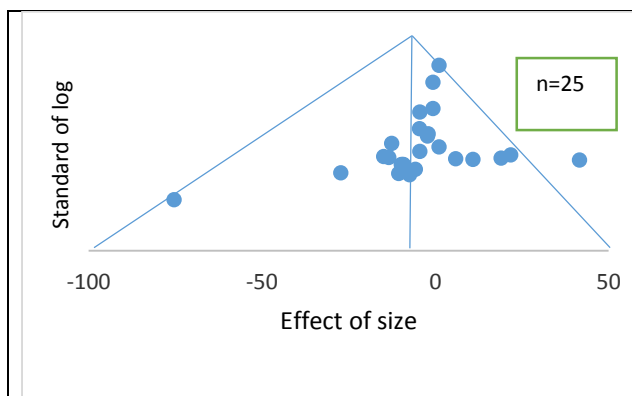


Fig.19- Funnel plot for GY (kg. ha⁻¹)

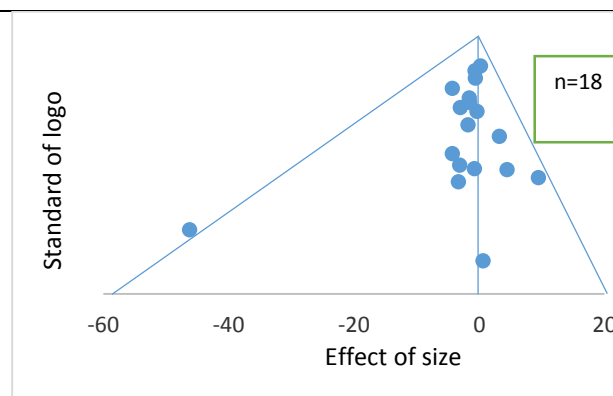


Fig.20- Funnel plot for GN/H

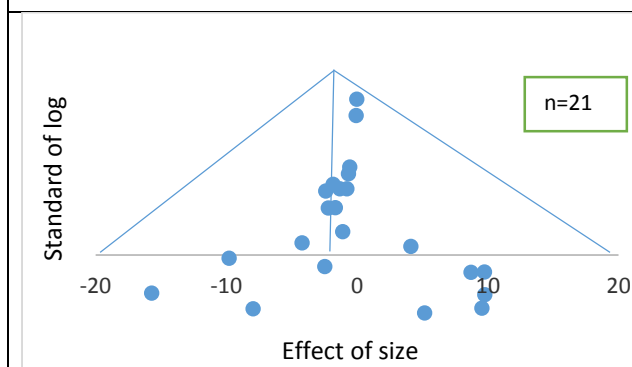


Fig. 21- Funnel plot forTGW (g).

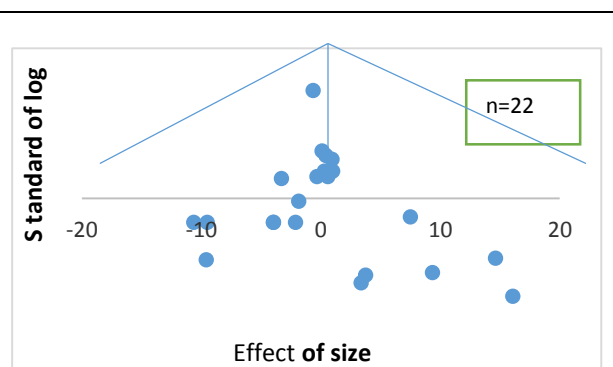


Fig.22- Funnel plot for GOP (%)

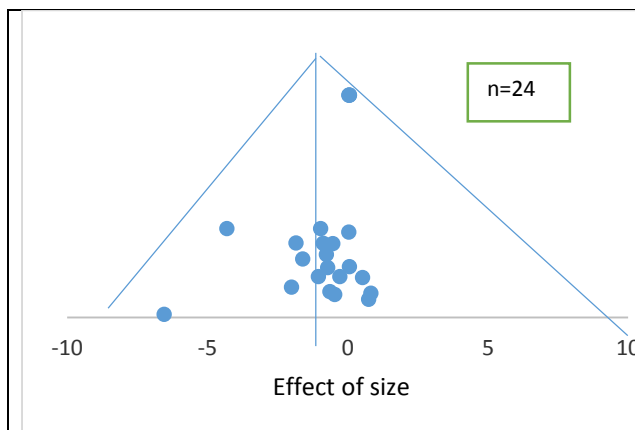


Fig.23- Funnel plot for HD (cm)

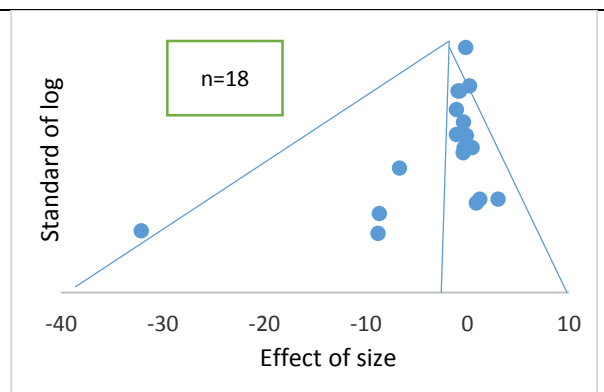


Fig.24- Funnel plot for PH (cm)

Limitations

Meta-analyses face the problem of publication bias. Asymmetry in funnel plots can give information about a publication bias, our statistical analysis of publication bias resulted in biases to both overly positive and overly negative results, but the bias identified is only moderate, and we thus refrained from adjusting the data to explicitly account for that but we refrain from further interpretation. Regarding variables of potential relevance that have not been covered.

Discussion

In this study, we seek to investigate the effects of planting date on yield and yield components and some morphological traits and qualitative yield such as GOP in sunflower oil. Planting sunflower oil among 40 articles has been done in spring in cold to semi-cold regions and winter planting in semi-warm to warm regions. Given that the physiological zero of the plant is 7-10° C Zamani et al. (2005); Ghadir et al. (2007) Qadir Et al (2013). Therefore, the best time to plant oil sunflowers in Iran and the world for spring planting in mid-May to mid-June (80-170 JD), and in subtropical to tropical regions from mid-February to mid-March (1-80 JD). The results of this study showed that the planting date range is 1-170 JD, significantly affected on GY, TGW, HD, GN/H (Fig 2, 3, 4 and 5). The mentioned traits had an increasing trend under the influence of planting date (Fig.7, 8, 9, 11). The effect of planting date on the GOP in the range of 263-387 JD range was significant (Fig.6). According to the regression diagram, the GOP under the influence of planting date was associated with a decreasing trend (Fig.10). Environmental factors have affected the growth of hazelnut, GOP, oil yield and its quality. Among environmental factors, temperature is considered as the most important factor and changes in planting date change the temperature of each of the phenological stages. The growth and development of the plant is effective, so the appropriate planting date, while affecting the rate of vegetative growth and increasing plant vigor for the more developed reproductive part, increases the number of flowers and seeds in plant. Early sowing of sunflower due to the temperature below zero is physiologically suitable, causes no seed germination and seed contamination at the time of germination. Early planting in saline soil has been effective in improving GY, TGW, GN/H (Kochehbaghi et al., 2009).

According to Figure 6, GY and grain oil yield traits are obtained in early spring planting dates and the amount of these traits will be reduced with planting delay. Early planting date does not have much effect on increasing yield, but due to increasing the length of the plant growth period, it will delay the next planting and increase costs and thus reduce the farmer's income. Matching delayed planting in many cases, the plant faces high temperatures during the growing season, which in turn increases the initial growth of the stem and reduces the length of the flowering period. Various studies by Johnson et al., (1972), Andrade (1995),

Uger and Thomson (1982) showed that high GY in sunflower when the grain development stages are at moderate temperatures, is achieved. Environmental factors affect the HD trait according to sunflower more than genotype so that with delay in planting and facing unfavorable environmental conditions, especially high temperatures, the growth period of the plant is shortened and the average HD per plant is reduced (Fig.2). For this reason, the longer the growth period of the plant delay of planting date to temperature above zero is physiological germination in the region reduces germination power and reduces the growth and delay of seedling emergence and thus reduces PH. The PH depends on the selected genotype and other factors such as nitrogen fertilizer application rate, soil type, soil salinity, planting density (Fig.1). Delay of sowing from the optimal time significantly reduces GY by reducing the number of grain produced per square meter and lack of late planting date also not only reduces yield due to reduced growth period and consequently reduces the efficiency of using environmental resources air and soil (Fig.4) but also due to the time of harvest with autumn rainfall, causes Obstacles to be created for the next crop planting time in rotation. According to José et al. (2004) planting dates 101, 103, 110 and 125 JD, for four consecutive years, no suitable trend and relationship was observed between planting date and TGW, but a significant relationship was observed between planting date and increase in the number of grain per square meter (Fig.5). Meta-analysis of each study showed that the highest TGW gain (9.76) on planting date is in mid-August (228 JD), the highest PH by weight (3.04) on planting date is 2 December (347 JDD), the highest performance increase with weight (41.64) is on March 15 (74 JD), The highest increase in the GN/H, by weight (9.79) on the date of sowing February 13 (44 JD), the highest increase in the GOP by weight (21.71) on the date of sowing is in mid-September (259 JD). The largest increase in the HD with weight (4.35) on planting date is August 29 (242 JD), d among the 40 meta-analytic studies were associated. Therefore, according to the final goal in this study, the best sowing date in terms of GY can be obtained in the planting date of 1-80 JD due to the increase in the GN/H. Also, the best treatment for planting date was achieved to the maximum yield of grain oil in the range of 171-263 JD. The purpose of investigating changes in planting date in 40 studies based on meta-analysis was to achieve the desired temperature for all important phenological stages of the plant that face the desired temperature and are safe from temperature stress, which can be based on latitude and longitude for similar areas from these favorable planting dates to achieve more economic production.

Results

In this meta-analysis, we found that delay in sowing date reduced traits such as GY, GN/H, GOP, PH, HD, but had a positive effect on TGW and an increasing trend was observed. Also, for the GOP, there were very few changes at the same time as the planting date changes. Due to the dispersion of the studied sites in 40 articles, the contradictory results confirm that the effects of planting date are not the main reason for the changes in the measured traits and should be due to other variables such as plant cultivar, crop input management and geographic coordinates. The geographical location of the farm should be considered in meta-analysis. The increasing trend of the studied traits was observed according to the effect intensity diagrams and the mean of the traits in the range of planting date 1-117 JD. According to the results of funnel diagrams, the selected articles were heterogeneous in such a way that the negative and positive effects of planting date were observed and the range of planting date was varied and the contradictory results were not unexpected. According to the accumulation diagrams, changes in the studied traits are not dependent on planting dates, so planting date is not considered as the main factor affecting the GY and its GY components in oil sunflower. The best time for spring planting is in mid-May to mid-June (80-170 JD) and in subtropical to tropical regions, from mid-February to mid-March (1-80 JD). The present results support such a relationship. Based on the present results and due to the homogeneity. In these 25 studies ,considering the results of meta-regression no negative correlation was seen in the traits of the number of seeds in plate and the yield .but for other traits no correlation was seen .on the other hand the results of the accumulation chart also showed that the minimum and the maximum effect size were related to the studies that in addition to the cultivation date had studied the cultivar and cultivation methods including density .so it is recommended that meta-analysis be done on the other factors,too

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