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Climatic zonation planting sunflower cultivation in Kurdistan Province

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Abstract

In the current investigation, evaporation and transpiration potential were also estimated by means of FAO Penman- Monteith evapotranspiration estimation method and Deviation from Optimum Percentage (DOP) technique by climatic elements (min-max temperature, relative humidity, wind speed and radiation) during at least 10 years statistical period regarding sunflower phenological conditions in Kurdistan Province. The results of this study indicate that the optimal date for cultivation of autumnal Canola in high and cold- weather lands (Saghez and Baneh West) is the end of October. This point is important in terms of date of cultivation and production of commercial product. According to the acquired farming calendar, end of October is the most appropriate time for autumnal cultivation in this area and thus date of harvest will be the end of August.

Key words: Zoning, Agro-Climate, Kurdistan (Province), sunflower

Introduction

Sunflower, *Helianthus annuus, L*, is an important oil crop worldwide. Moreover, its hardy and superior to sorghum (Sorghum bicolar Moench) in drought tolerance (Rachid *etal*., 1993). Under dryland conditions, sunflower extractswater from deeper soil profile to enable the crop tolerate prolonged dry periods (Unger *et al.*,1976; Meinke *et al* .,1993). In the tropics, cultivation of sunflower is increasingly spreading to different ecological zones and seasons of the year, but the post rainy season period offers a unique cropping opportunity for sunflower in the humid zones of Nigeria (Ogunremi, 1988, Fagbamigbe & Adeoye, 1999). However, soil water reserve is a valuable resource important to the exploitation of the potentials offered by the post rainy season cropping period (Agele *et al*,. 1999). This period is characterised by concurrent stresses due to extremely high soil and air temperatures, solar intensity and vapour pressure deficits (atmospheric dryness) and severe soil moisture deficits. In order to improve the productivity of sunflower in the various cropping opportunities, it is necessary to understand production risks with decision options in circumstances of soil and climatic factors of a growing season. Soil water availability is a major factor affecting crop productivity in the different cropping systems in many parts of the world and the correct estimation of soil water supply is important to the efficiency of yield prediction in crop models (Monteith, 1986). Leaf area development has generally been predicted using functions of temperature or more specifically thermal time (Sinclair, 1982; Hammer *et al*., 1993). In situations where the supply of water to the root system does not meet the evaporative demand on the canopy, crops can restrict water use by reducing the loss per unit area and/or the extent of the transpiring area (Cox & Jollif,

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1986). An adjustment to the leaf area enables the crop to match the reduced evaporative demand to the dwindling water supply from a possibly expanding root system, this is an appropriate option under conditions of high evaporative demand. Sunflower combines high yield with great adaptation capacity. Besides, the characteristically high photosynthetic capacity and HI makes this crop viable for contrasting environments. The crop is characterised by unusually high photosynthetic rates (for a C3 crop) and large values of RUE (4.8 – 5.0MJ of intercepted PAR) similar to that of maize (Kiniry et al., 1992). Radiation use efficiency and radiation conversion coefficients provide basis for understanding environmental influences on crop productivity (Gilett et al., 2001). High temperatures aggravates the effects of drought stress on crops; it decreases RUE and dry matter accumulation possibly due to increased loss of photosynthates via respiration. Similarly, radiation conversion coefficient (E) which ranges from 1.2 – 1.7 g dm/MJ for most crops is affected by temperature (Takami *et al.*, 2002). Climatic variability is a major cause of inability of agricultural crops to achieve potential yield.

Data and Methodologies

In this study, by means of statistical data for at least 10 years Kurdistan province agro climatic elements in have been evaluated and zoned.

FAO- Penman- Montieth method is used as one of the most reliable techniques for ETO estimation.
FAO- Penman- Montieth equation is expressed as follows:

(Eq. 1)

$$ET_o = \frac{0.408\Delta(R_n - G) + [890/(T+273)]U_2(e_a - e_d)}{\Delta + \gamma(1 + 0.34U_2)}$$

Where:
ETo = Evaporation – Transpiration of reference plant (mm/ day)
R_n = Net radiation on flora level $(MJm^{-2}d^{-1})$
T = Mean temperature at height 2m above ground level $(^o c)$
U_2 = Wind speed at height 2m above ground level (ms^{-1})
$e_a - e_d$ = Shortage of vapor pressure at height 2m (kpa)
Δ = Vapor pressure slope $(KPa^o c^{-1})$
γ = Humidity coefficient $(KPa^o c^{-1})$
G = Heat flux into soil $(MJm^{-2}d^{-1})$

It should be explained that figures of wind speed are considered at 10m height and they have been converted into figures for 2m height which have been set as basis for operation means of Eq. 3 in this study:

(Eq. 2)

$$u2 - u - \frac{4.87}{\ln(67.87zw - 5.42)}$$

Where *U* denotes the wind speed (m/s) at height 2m, *U2* is wind speed at the given height (m/s), and *ZW* as height of anemometer, which here is 10m and equal to height of anemometer derricks in synoptic substations.

2- Deviation from Optimum Percentage (DOP) method

There are 4 phenological phases in sunflower plant and it has one optimum or optimal temperature per phase where its maximum growth occurs at this optimum temperature. The spatial optimums may be characterized within several time intervals, especially year months through identifying and determination of these optimums for any phenological phase and mean daily temperature derived from detection of minimum and maximum daily value and in fact those points with minimum deviation from optimum conditions are considered as optimal location. To acquire various spatial optimums in this technique, initially optimums or optimal temperatures were determined and then by considering daily mean statistics, the values of deviation from optimum conditions were computed for total year. Then at next step, difference among the given means from optimum limit was calculated and as a result rate of deviation from optimum conditions is obtained for the above locations.

Results and Conclusion

Agroclimatic elements are affected by meteorological and plant- related factors and administrative and environmental conditions. The effective meteorological factors on evaporation- transpiration on plants and agro- meteorological processes are radiation, weather temperature, and wind speed. Thus, with respect to importance of the above factors, the effort has been made to estimate and analyze Evapotranspiration Potential (ETO) and to study on water requirement and the efficient rainfall in the region. As it observed in Table 2, the maximum and minimum rates of evaporation and transpiration have taken place respectively in July and January. Active temperature degrees are one of the other agroclimatic methods for determination of optimum times based on the date of latest min threshold events at any phenological stage (sunflower) that has been used in this investigation. Sum of daily temperatures was used with positive values but only for those days with temperatures, which are higher than average biological level or zero degree of activity. In this study, the basis point for calculation of active thermal coefficients is determined based on two modes: One is based on the min thresholds of the plant (sunflower) at each of phenological stages and the latter is zero point (0C°). Given these plant species extremely depend on temperature so statistical daily temperature has been used as min and max detection data for phenology of plant species (sunflower). Date of completion for each of phenological stages has been determined with identifying accurately each of thresholds in plant's phenological phases (sunflower) and daily temperatures. Date of the min biological threshold event was considered more than 10C° to activate the plant (sunflower) in each of substations. It requires using 100, 500, 1000, and 1800 thermal units (Btu) higher than zero degree (0C°) to achieve date of completion of phenological cultivation stage (sunflower) respectively in each of cultivation stage until budding, flowering phase, at the end of flowering step. (Table1) Date of completion of phenological stages in sunflower plant.

Table 1: Date of completion of phenological stages in sunflower plant

Substation	Height	Date of minimum threshold event	Cultivation until budding	Flowering	End of flowering	Total maturation
Saghez	1485	15^{st} May	28^{th} May	18^{th} June	17^{th} July	27^{h} August
Divandareh	1365	12^{st} May	26^{th} May	17^{th} June	13^{th} July	20^{th} August
Dehgolan	75	29^{th} April	15^{th} May	5^{nd} June	4^{rd} July	11^{th} August
Baneh	1806	12^{st} May	30^{th} May	28^{th} June	22^{th} July	22^{th} August

Conclusion

In addition to the limitations of our climate challenges in agriculture. There are already farming activities and the development and growth of this sector Challenges facing them. Among cereals, wheat and barley are the main agricultural activities in arid and semi-arid countries. in Kangavar substation and the maxi values respectively in Sarpolzahab and Kermanshah substations. Thus, it may be found that annual rainfall in most of the studied substations can meet the water requirement for cultivation of dry-farmed wheat crop and based on rate of evaporation and transpiration and water need (plant's consuming water) an appropriate relationship may be observed among annual precipitations and cultivation of dry-farmed wheat in terms of location between studied substations. With respect to the derived results from Deviation from Optimum Percentage (DOP) technique at germination and budding phases, Saghez substation has the lowest deviation with more optimal conditions compared to other substations. At flowering phase, Saghez substation has the less deviation from optimum criterion than other substations but there is no stark difference in terms of DOP at this stage. At maturation stage, sunflower in Saghez substation has less deviation in this regard. After Saghez, West Baneh and Divandareh substations have the lower deviation while there is more deviation in Dehgolan and Divandareh substations.

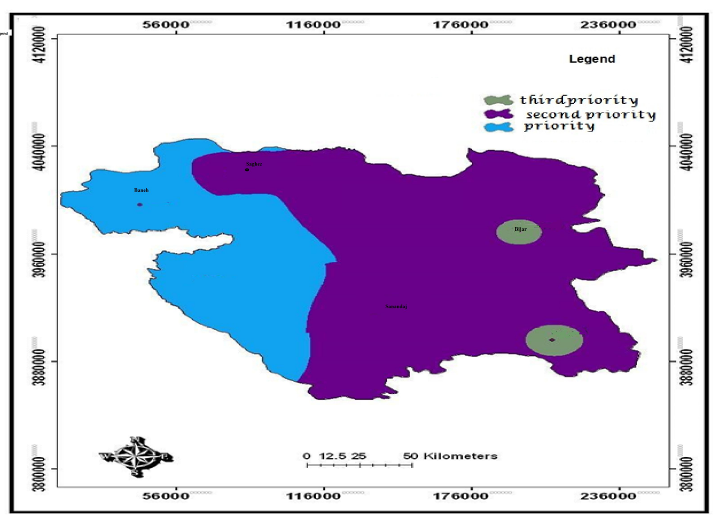

Figure (1). Suitable for the cultivation of sunflower in Kurdistan

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