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Zoning of Canola Cultivation Based on Climatic Temperature Needs Using of GIS in Golestan Province

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Abstract

Studying of climatic elements are one of the most important factors influencing on agricultural crops production and developing of agriculture activities in every region that led to increasing production . by studying of agro climatology can be determined potential facilities in different areas and used optimum of facilities . this research was established by determining temperature potential of ecological capacity of canola cultivation areas in Golestan province . climatic grouping by Dumartin method, was established to general determine of region climate by using of suitable cultivation temperature(15-20°c) and Vibul method (75% probability)is determined cultivation date . based on measuring of effective required day degree in every steps , is measured given date to phenology step .suitable and limited temperatures different steps of canola phenology is derived from different sources and measured its occurrence probability in studied region . medium relation ship of canola performance and suitable and limited temperatures was studied in different steps of phenology . after organizing and forming of temperature layers using of regression equations , the cultivation regions are divided in to four areas , very desirable , desirable , rather desirable and undesirable .

Key words : Zoning, Canola, Thermal needs, Golestan province

Introduction

Introduction and cultivation of new crops in a given environment require management practices and trait selection that enable the crop species to perform to its potential. Canola is an important oilseed crop (Downey 1990, Zhang *et al.* 2003) and its cultivation is expanding, particularly in the western world (FAO 2006), because of its importance as both an oilseed and a bio-diesel crop. Winter-grown canola has attracted attention from both producers and researchers since its introduction in the 1980s (Rife and Zeinali, 2003). Canola is cultivated both during winter and spring seasons in United States that expose the crop to winter kill and frost and high temperatures, respectively, during the reproductive period. The temperatures during winter and spring are known to influence all the crucial steps of the reproductive cycle including gametogenesis, pollination, fertilization and embryogenesis (Lardon and Triboi-Blondel 1994, Angadi*et al.* 2000). Temperature stress events, which are being experienced now, are expected to intensify because of an increase in emission of greenhouse gases and associated changes in climate. Climate models project an increase in the surface temperature of the Earth by 1 to 11C by 2100

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(Houghton *et al.* 2001, Stainforth*et al.* 2005). Additionally, short episodes of extreme climatic events including low and high temperatures are predicted to occur more frequently in the near future (Meehl and Tebaldi 2004). Studies have shown that these projected changes in climate drastically reduce crop yields when they coincide with the reproductive stage of plant growth (Hall 1992, Reddy *et al.* 1992, 1997). The yield of canola crop grown both in winter and spring is reduced on exposure to low and high temperatures, respectively. Winter-grown canola blooms in March and April in the US mid-south and temperatures <10C are not uncommon during that period (Reddy *et al.* 1995). (JinLing, 1997) observed that low temperatures result in fewer mature seeds in canola because of the reduced fertilization potential of pollen grains. This could be due to the sensitivity of the binucleate stage of pollen grains to short periods of freezing temperature (3C) for4 h; Lardon and Triboi-Blondel 1994). Similarly, high temperatures inhibit reproductive success. (Angadi*et al.* 2000) reported that exposing Brassica species to 35/15C day/night temperatures for 7 days during early flowering rather than during early pod development caused greater yield reduction. The yield reduction was attributed to flower abortion caused by pollen infertility. Consequently, the early stages of anther development in Brassica oleracea var. italica L. showed high sensitivity to the temperature treatment of 35C for 7 days compared with the same stress during later growth stages (Bjo¨rkman and Pearson,1998).Therefore, knowledge of the canola pollen germination processes, cardinal temperature and temperature adaptability range (TAR, Tmax–Tmin; Reddy and Kakani, 2007) will help us to design breeding strategies to sustain canola production in extreme climatic conditions expected in the future.

Geographical situation of studied region

Golestan province has 21500 km area . this province is located in 36° and 44′ to 38°and 5′northern latitude and 51°and 53′t0 56° and 14′eastern longitude and in the north restricted to Turkamanistan in the south to Semnan province in the east to birjand province and in the west to Caspian sea and Golestan province . weather based on temperature and rain fall traits is divided in to 3 groups humid moderate , moderate and cold mountainous , semi dry or semi desert . studies region of this survey included recent agricultural land in Golestan province.

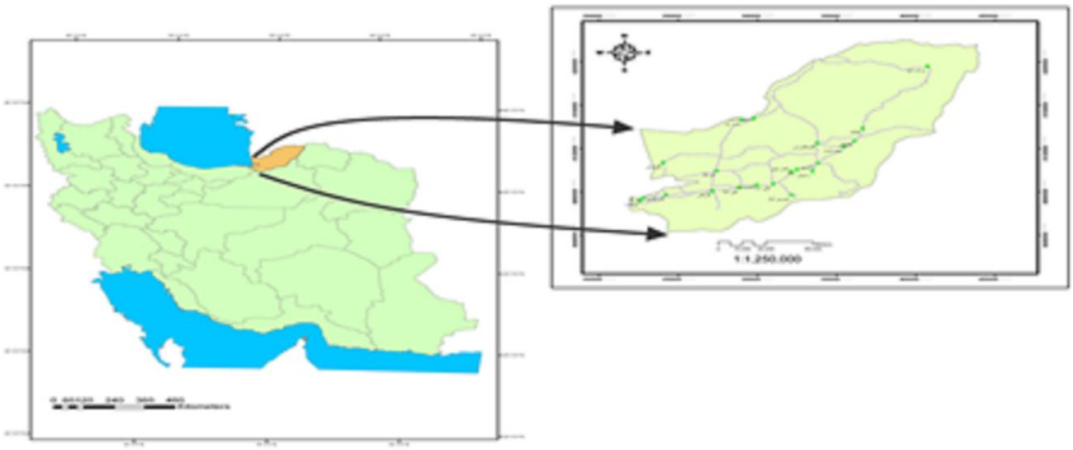

Fig 1. studied region

Material and method

Studied region for this research in Golestan province , which is located in the north of Iran . in this research is collected statistical data of four synoptic stations from establishment to 1390.

studied data in this research including temperature elements (yearly average temperature , yearly minimum average temperature , yearly maximum average , germination temperature , flowering temperature).

According to this fact that temperature is one of the determinant factors in geography of agricultural plants and due to this fact that temperature and coldness stress have important role in reducing of agricultural and horticultural yield , so in research , this factor was analyzed during growth sensitive periods. After determining of starting and ending date of growth sensitive periods based on temperature factor that is consider important metrological and climatological variant in canola cultivation and its value determined planting in every region , studied and divided yearly average temperature and its value during germination and flowering steps in province using of GIS . finally by using of grouping weight method , all of the maps associated with yearly average temperature , yearly minimum average temperature , yearly maximum average temperature , germination temperature , flowering temperature combined in GIS environment and finally , zoning map of lands is provided for canola cultivation in province . For grouping of susceptible regions is selected four zones . 1- very desirable , desirable , rather desirable. Undesirable

Results and Discussion

Canola is special for cold regions . but is sensitive to temperature changes ., and reacted to rate . studies show that different values of canola in different climatic regions have different reactions to environment conditions . in the study that is established on canola values in different ,cold , dry, and semi dry regions, determined that responses of these value to dry and semi dry regions compared to cold and semi cold regions is different and these differences are significant . yet , between cold and semi cold regions in spite of difference in responses , this difference isn't significant . thermal changes range in cold and semi cold regions is located in desirable condition range and changes aren't so sever that led to heat or cold stress for plant (Khoshal,Dastjerdi and Bratian ,2009:36)

Finding place practice of canola in agricultural lands in Golestan province :

For finding places of susceptible regions for sowing of canola , for adapting to environmental needs is acted based on simple limitation method . at first , ecological and agricultural needs of plant using of available sources is determined and classified .

agricultural and ecological zoning of lands for cultivating canola in Golestan province

results show that agricultural and ecological zoning of canola based on analyzing data or climatic , topography , water and soil is possible and geographical sites as a suitable tools for analyzing data can determined ranges with more validity and presented more valid zoning . results of finding place maps for cultivating canola in Golestan showed in four groups in fig 2 in these maps from south to north and from west to east is reduced from desirability of environmental factors and zoning groups so that lands with suitable and desirable capacity for cultivating canola is determined in the south and middle part of province. 21 percent of agricultural lands having potential in production that 34 percent are located in very susceptible zone . this zone having potential between 80-100 percent . based on multi sides view of this study to ecological factors , this zone is suitable place for meeting environmental and agricultural needs . this susceptible zone is seen in fields of 3 south cities , Aliabad katoul, Ramyan ,and Gorgan (fig3). Reason of restricted of this region in recent agricultural lands in Golestan province is reducing quality and quantity of environmental factors like soil fertility and water sources. Every year , in these very susceptible regions seen the planting of several lucrative productions that play important role in reducing quality and quantity of sources and reducing degree of lands . it is seem that a plan for systematic planting model can be effective in keeping of zone and sustainability of environment.

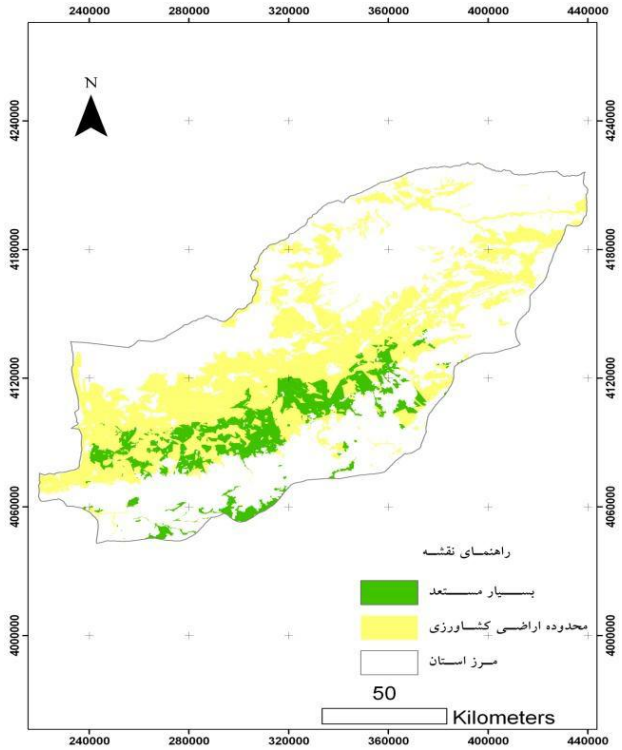

Fig 2 –assessment of capacity of agricultural lands in Golestan province .

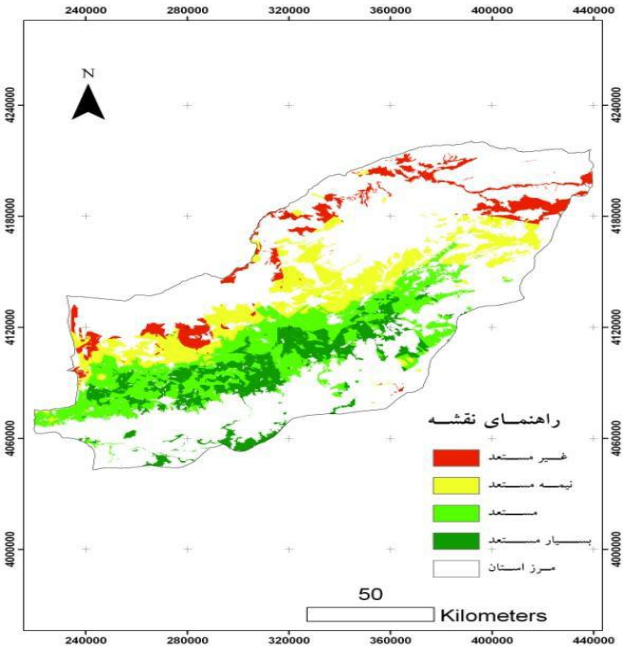

Fig3- very susceptible zone for cultivating canola, agricultural lands in Golestan province

The zone of Susceptible lands between four zones with 275209 area has allocated most area to itself . this zone have desirable conditions and of course a little lower than very susceptible zone 400mm falling, light and medium soil texture and rather fertility of soil led to that these regions have potential 80

percent for canola cultivation (fig 2). Lands in every zone presented climatologic and environmental single traits , and required single planning . based on effective role of canola in meta fields and using of rain fall , developing of canola in form of dry farming is possible . and there is adaptability of autumn cultivation to ecological factors in this zone . in this study , it is determined that most of studied agricultural lands have climatic topographically (temperature) suitable condition for producing of canola and ther isn't any limitation in this area .

Conclusion

It is identified b y determining of capacities and environmental limitations of canola cultivation in 56 percent of agricultural lands that having suitable capacity of producing canola that 38 percent is located in the south and middle of province. in these semi susceptible or non susceptible regions of the north and north east by a series of actions can be developed quality of agricultural lands . based on limitation in this zone , it is suggested actions including increasing of soil organic material, and improving of soil fertility , washing out of salty lands and its drainage , adjusting of suitable agricultural rotation , using of resistance value to available environmental stress , increasing water efficiency and using of modern irrigation for improving of these region

Golestan province is one of the susceptible regions for agriculture among provinces in country and studying of agricultural crops specially oil seeds based on impact of the weather and physical factors of lands in region is very important . results of analyzing data showing that temperature and solar radiation play important role in growing of this agricultural crop. In addition to zoning maps, thermal and climatic needs showing following results :

Very desirable regions: because of suitable climatic condition during canola cultivation period will have high yield that having following condition or combination of discussed conditions:

A – probability of suitable temperature occurrence from planting to germinating is more than 50 percent .

B - probability of minimum temperature occurrence during day and night more than zero in flowering step is more than 90 percent .

C – probability of maximum temperatures27 °c occurrence in flowering step is more than 94 percent .

Desirable regions : having rather weaker condition to susceptible regions of very desirable , but it is expected rather good yield from planting canola and having following condition or combination of discussed conditions :

A - probability of suitable temperature occurrence from planting to germinating is between 40- 50 percent

B - probability of minimum temperature occurrence during day and night more than zero in flowering step is between 85- 90 percent

C - – probability of maximum temperatures27 °c occurrence in flowering step is between 92- 94 percent .

Rather desirable regions : having rather desirable climatic condition comparing to 1 and 2 regions but in years which the conditions for cultivating is suitable , derived economical yield and having following condition or combination of discussed conditions .:

A - probability of suitable temperature occurrence from planting to germinating is between 30- 40 percent

B - probability of minimum temperature occurrence during day and night more than zero in flowering step is between80- 85 percent

C - probability of maximum temperatures27 °c occurrence in flowering step is between 90- 92 percent

Undesirable regions : having rather undesirable climatic condition to above conditions and planting canola in these regions having climatic limitations and its planting isn't lucrative and having following condition or combination of discussed conditions

A - probability of suitable temperature occurrence from planting to germinating is less than 30 percent

B - probability of minimum temperature occurrence during day and night more than zero in flowering step is less than 80 percent
C - probability of maximum temperatures27 °c occurrence in flowering step is less than 90 percent

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