

Development of Zanjan province dry land wheat atlas

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Abstract: In this study we analysed climate capabilities and limitations for dry land wheat. The study takes into account and analyzed the rainfall and temperature data of the research region. In the first stage, proper planting date was defined according to the first rain after September. Then the different levels of dry planting wheat's growth was calculated by the GDD method. In the following stage annually and in autumn, winter, spring and June rainfall were reviewed and the average was calculated. The probability of germination temperatures, maximum temperature 25 and 30 °C in the flowering stage and grain filling stage was also calculated. The calculated quantities in the GIS system by using the overlap method: were first given a weighing value and afterwards were incorporated. Then finally Zanjan Provinces Dry Land Wheat Atlas area was classified in 4 zones: Very suitable lands, Suitable land, Average lands and Unsuitable lands was prepared.

Keywords: Rainfall, GIS, GDD, Planting date.

Riassunto: In questo studio sono state analizzate le potenzialità ed i limiti climatici per la coltivazione del frumento non irrigato. Lo studio prende in considerazione e analizza i dati di precipitazioni e temperatura relativi all'areale oggetto della ricerca. Nella prima fase, è stata definita la data di semina sulla base della prima pioggia verificatasi dopo il mese di settembre. Successivamente i diversi livelli di crescita del grano non irrigato sono stati stimati con il metodo GDD. Nella fase successiva le precipitazioni sono state ricalcolate sia livello annuale sia per le diverse stagioni e per il mese di giugno e si è provveduto a calcolarne la media. È stata calcolata inoltre la probabilità del verificarsi di temperature di germinazione, di temperature massime di 25 e 30° C nella fase di fioritura e riempimento delle cariossidi. Le quantità calcolate sono state riportate nel sistema GIS, utilizzando il metodo di sovrapposizione. Alla fine sono state distinte 4 aree di coltivazione del frumento non irrigato nella Provincia Zanjan. È stato elaborato un atlante in cui si differenziano terreni molto adatti, terreni adatti, terreni medi e terreni inadatti.

Parole chiave: Pioggia, GIS, GDD, data di impianto.

INTRODUCTION

Various studies around the world have taken place on the relation between climate factors and plant development. In wheat as the most important crop, needed for humans, we face some national and international articles, which are mentioned, in the following. Norwood (2000), studied on planting dryland wheat in the great plains of Kansas. Sharma *et al.* (2006) evaluated the effect at high temperature on grain growth in different types of wheat. Ouda *et al.* (2005) evaluated the effect of planting dates and water stress on wheat production in the south delta. Farajzadeh and Taklobighash (2001) did Bandab agroclimatic area of Hamadan province in a GIS area according to dryland wheat planting.

MATERIALS AND METHODS

This study was conducted in Zanjan province (Iran). After the data was gathered, because of lack of long term statistical stations in Zanjan, the statistics were

gathered from the neighbor provinces. At first, the data gaps were filled according to the difference and ratio methods.

Also the run test exam was used to evaluate data homogeneity. Afterwards the specified region's climate was classified by Jamab according Domarton and Ambrejeh climate thumb methods (personal communication). In the next level, rainfall geographical distributions were evaluated annually and in autumn, winter, spring and June month intervals. The first day in which the precipitation in one or two consecutive days is more than 5 mm was determined analyzing the precipitation series (Bazgir 1999). Consequently the dryland wheat sowing date was determined.

According to the achieved sowing dates, and due to the required thermal units for different dryland wheat levels development, in the region, the results are as following:

- Planting until becoming green: 180 degree day
- Planting until the beginning of flowering stage: 1300 degree day
- Planting until the finishing of flowering stage: 1500 degree day
- Planting until complete growth: 2300 degree day (Behnia, 1997)

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GROWTH DURATION	D				SOWING DATE	STATION
	2000	1500	1000	500		
209	20 APR	8 JAN	9 DEC	20 CT	24 SEP	Anzali
274	19 JULY	15 JUN	22 MAY	5 Nov	21 OCT	bijar
247	19 JUNE	10 MAY	12 APR	28 oct	16 OCT	guzvin
275	12 JULY	5 JUNE	9 MAY	25 oct	11 OCT	gorveh
272	18 JULY	12 JUNE	21 MAY	6 NOV	20 OCT	hamaclan
309	9 AUG	29 JUNE	6 JUNE	5 NOV	5 OCT	khalkhal
279	14 JULY	6 JUNE	15 MAY	23 OCT	9 OCT	khodabandeh
268	4 JULY	24 MAY	26 APR	24 OCT	10 OCT	khoramdarreh
203	3 APR	6 MARH	23 JAN	23 OCT	13 OCT	manjil
253	23 JUN	17 MAY	5 APR	26 OCT	14 OCT	mianeh
210	21 APR	22 JAN	11 DEC	11 oct	24 OCT	Rasht
294	29 JULY	21 JUN	31 MAY	26 OCT	9 OCT	Takab
281	14 JULY	4 JUN	7 MAY	22 OCT	7 OCT	Zanjan
309	15 AUG	8 JULY	17 JUN	31 OCT	11 OCT	zarineh

Tab. 1 - Sowing date and the best dates to achieve the required GDD for each growth stage.

Tab. 1 - Date di semina e la migliore data per ottenere il GDD richiesto per ogni fase di crescita.

The wheat growth periods were defined as: becoming green, flowering and grain filling stages. The dryland wheat temperature requirement were evaluated and the probability of wheat budding between 12°C to 20°C and also the probability of maximum 25°C daily or higher in flowering stage, and the probability of 30°C daily or higher in grain filling stage was calculated.

It should be noted that for all these calculations and for defining the best probabilistic distribution function, Excel and Hyfa software were used.

In the last step all the probabilities and calculated amounts in the GIS environment were converted into digital maps and by using overlapping method; all the layers were combined and finally the dryland wheat Atlas of Zanjan province was produced.

RESULTS AND DISCUSSION

The accuracy of the achieved data is limited and then these data must be modified according to real information based on farmers' polls.

The analysis of meteorological data for the last 15 years (1990 – 2004) evidenced that the lack of rainfalls of the last years causes drought period in this region then the budding season and the other growth stages had a delay. Despite the rainfall delays, the farmers sowed but some seeds were destroyed or their viability was reduced.

This research is only based on the climate data, it

could be taken into considerations other factors such as, terrain, topography of the region, soil type, lack of integrity and small pieces of farming land, farmers lack of awareness, using traditional methods, using proper digits and etc, to have an accurate determination on fertile lands.

CONCLUSIONS

The analysis of climatic data in the Zanjan province defines a cold semi-arid climate. Generally it has the conditions for planting dryland wheat.

According to the dates of wheat growth stages, (Tab. 1), the shortest growth period is 203 days (Manjil) and the longest growth period was 309 days. (Khalkhaal and Zarineh Obato).

The final province map is divided in 4 regions according to the dryland wheat sowing vocation as follows (Fig. 1):

- Very suitable lands: (1152.5 km²) this region covers about 5.2% of whole Zanjan province's area and includes northern parts, center of Khodabandeh and eastern Ijroud.
- Suitable land: (10494.7 km²) this vast area represents about 47.35% of the province and includes most of the central parts of the province, northern and southern parts of Zanjan county, Mahneshan eastern parts, northern and western parts of Abhar, most areas of Khorramderreh east and

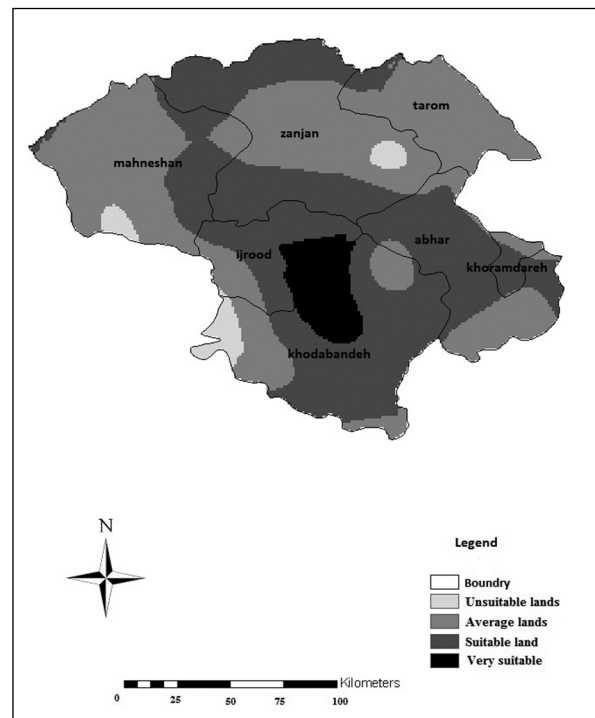


Fig. 1 - Zanjan province dry land wheat atlas.
Fig. 1 - Atlante del frumento non irrigato della Provincia di Zanjan.

center of Khodabandeh, and Ijroud counties east and north.

Average lands: (9891.8 km²). This area represents about 44.63% of the province. These areas are mainly located in Tarom county, center of Zanjan county, south of Abhar, west of Mahneshan, west of Ijroud and Khodabandeh. In these regions, dryland wheat cultivation could meet some problems due the possible drought period

Unsuitable lands. This area is about 2.82% (625 km²) of the whole province which is located in east of Zanjan county, west of Khodabandeh county and south of Mahneshan. This areas is no suitable for wheat cultivation for adverse climatic condition.

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