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Determination the phenology and using Geographic Information System (GIS) for management winter wild oat (*Avena ludoviciana*) in wheat fields

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Abstract

For managing the winter wild oat in wheat fields, four field experiments were conducted in four regions of Iran: Zanjan, Karaj, Varamin and Amol during 2006 and 2007. The predictive weed management maps were produced for Mazandaran province using Geographic Information System (GIS). The results showed that despite high variation in phenological stages during growing season at different sites of experiments, these stages were relatively similar when evaluated based on degree days. The starting and terminating time for application of post emergence herbicides for control of winter wild oat in wheat fields were determined 400 and 1000 GDD, respectively. Using prediction map that produced by GIS, the suitable time for starting and terminating post emergence chemical control (post emergence) and the suitable time for nitrogen fertilizer application in order to reduce competitive ability of winter wild oat against wheat in different regions of Mazandaran province could be determined.

Key words: Growing Degree Days (GDD), Comparative Phenology, Prediction map.

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Sattin *et al.* (1992) .(Reeves *et al.*, 1981)
(*Abuthilon theophrasti*)

.(Montazeri *et al.*, 2005)

Cudney *et al.* (1989) .

.(Khalaghani, 2007)

(*Avena ludoviciana*)

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(Shirliffe *et al.*, 2000)

.(Minbashi, 2009)

(GIS²)

(GDD¹)

Karimi and Siddiq, 1991; Andarzian *et al.* 2008; McMaster)
(and Wilhelm, 1997

Main *et al.* (2004) .

.(Romo and Eddleman, 1995)

GIS

(*Digitaria sanguinalis* (L.) Scop.)

.(Buhler *et al.*, 2000)

Mckarty (1985)

Carduus

Teuton *et al.* (2005)

Urochloa subquadripara (Trin.) R.D.Webster

(*Raphanus raphanistrum* L.)

2- Geographic Information System (GIS)

1- Growing degree days (GDD)

(*Avena ludoviciana*)

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(Anonymous, 2007)

(*Avena ludoviciana*)

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(Anonymous, 2003)

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(Bena Kashani *et al.*, 2006)

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$$\Theta_T = \sum_i^n [(T_{\max} + T_{\min}) / 2 - T_b]$$

$n \quad i$

$$\frac{T_{\min} \quad T_{\max}}{T_b}$$

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($\Theta_T = 0$)

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(Zadox *et al.*, 1974)

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Table 1- Wheat cultivars, soil texture, soil acidity and planting date of four regions in two-year experiment

Location	Wheat Cultivar	Soil Texture	Soil pH	Planting date of wheat and weeds during 2006-2007	Planting date of wheat and weeds during 2007-2008
Zanjan	Alvand	Sandy-Clay-Loam	7.63	5 Oct. 2006	19 Oct. 2007
Karaj	Pishtaz	Sandy-Clay-Loam	7.04	23 Oct. 2006	22 Oct. 2007
Varamin	Pishtaz	Clay-Loam	7.49	3 Nov. 2006	2 Nov.2007
Amol	Tajan	Clay-Loam	7.72	13 Nov. 2006	20 Nov 2007

Table 2. Suitable planting date of wheat in different climates of Mazandaran province

Climate Type	Suitable planting date
Semi humid and humid with temperate summer and very cold winter	From 7 Oct. to 22 Oct.
Semi humid and humid with temperate summer and cold winter	From 7 Oct. to 6 Nov.
Semi humid and humid with temperate summer and semi cold winter	From 23 Oct. to 6 Dec.
Semi humid and humid with temperate summer and relatively cold winter	From 6 Nov to 6 Dec.

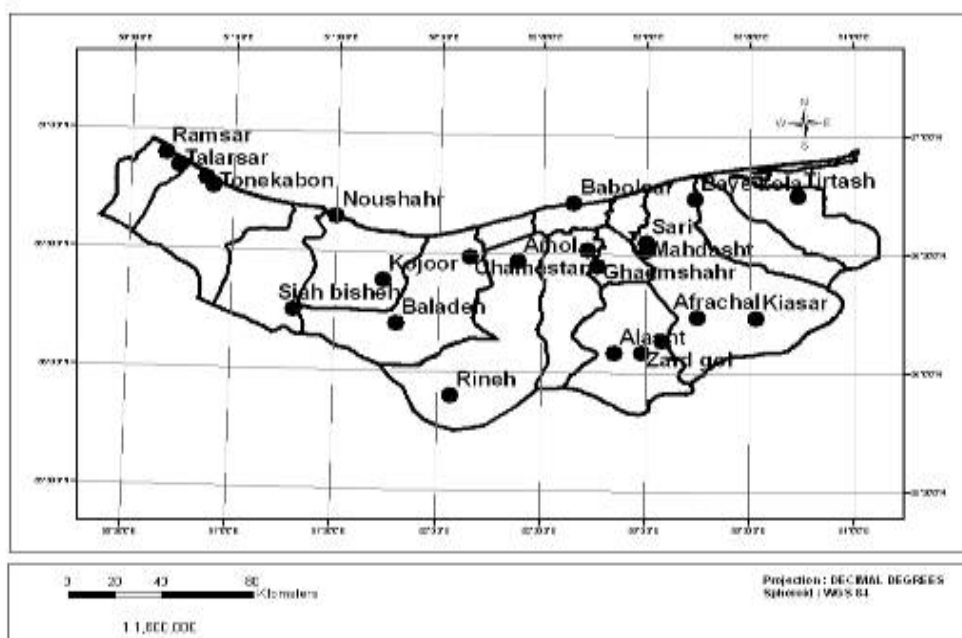


Fig.1. Georeferenced map of climatology stations in Mazandaran province

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(Minami, 2001) ArcMap

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(IDW)

(MSC)

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Georeference

Interpolation

Inverse Distance Weighted

Spline

Minimum Surface Curvature

Ordinary Point Krigging

Reclassify

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Cudney *et al.* (1989)

(*Avena fatua*)

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Shirtliff *et al.* (2000)

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Ampong-Nyarko and Datta, 1993;)

.(Dhima and Eleftherohorinos, 2001

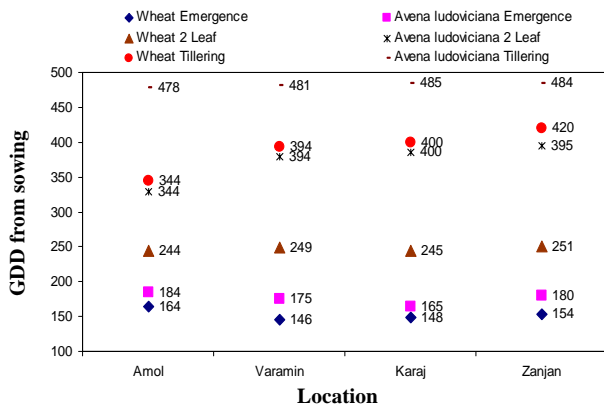
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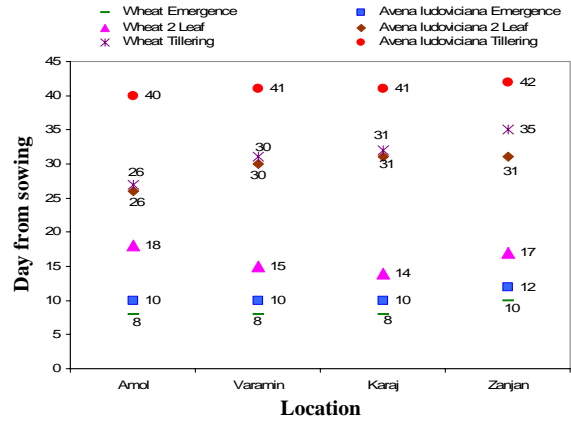
Carlson and)

.(Hill, 1985; Henson and Jordan, 1982

Ahmadvand and Sepehri (2004)



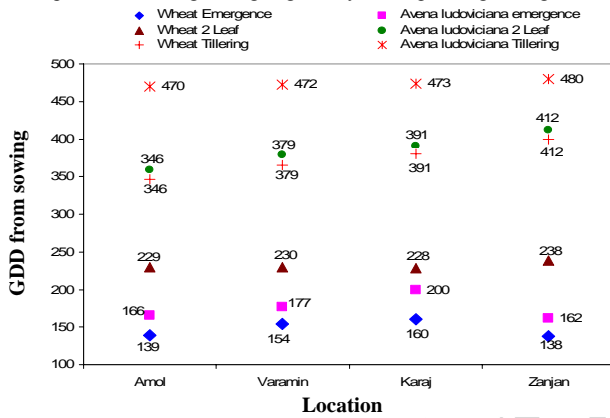
(*A. ludoviciana*)



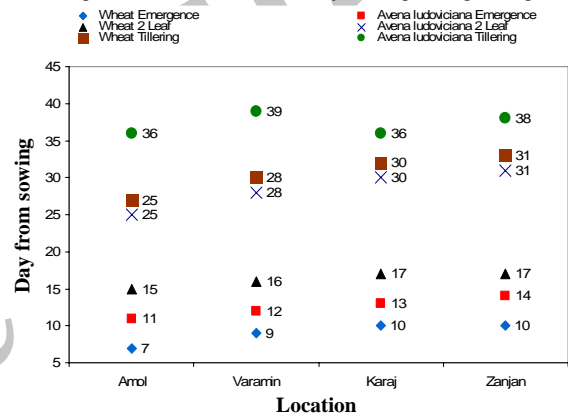
(*A. ludoviciana*)

Fig 3. Comparative phenology of wheat and winter wild oat in vegetative phase based on growing degree days from planting during 2007

Fig 2. Comparative phenology of wheat and winter wild oat in vegetative phase based on number of days from planting during 2007



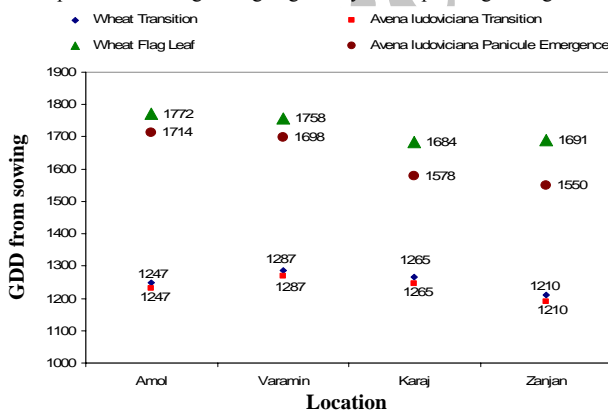
(*A. ludoviciana*)



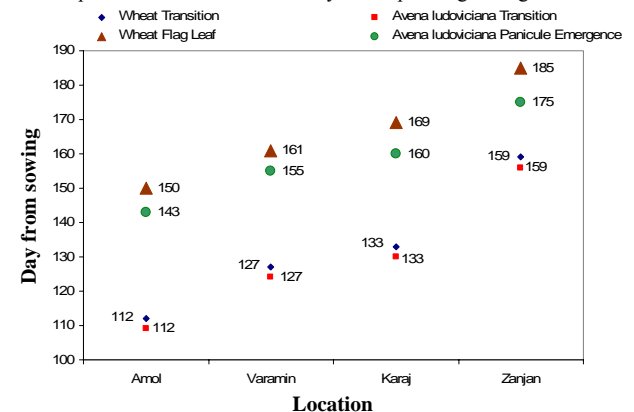
(*A. ludoviciana*)

Fig 5. Comparative phenology of wheat and winter wild oat in vegetative phase based on growing degree days from planting during 2008

Fig 4. Comparative phenology of wheat and winter wild oat in vegetative phase based on number of days from planting during 2008



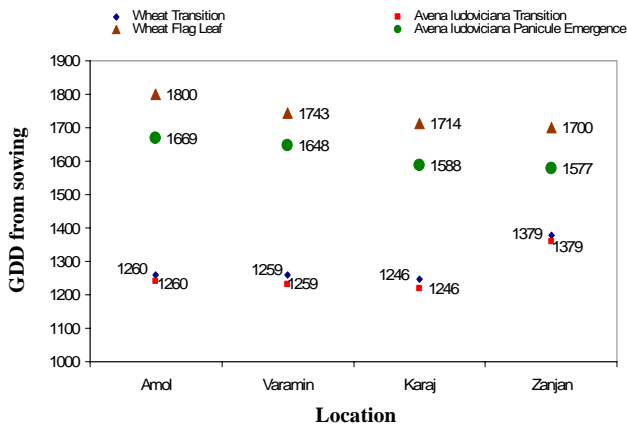
(*A. ludoviciana*)



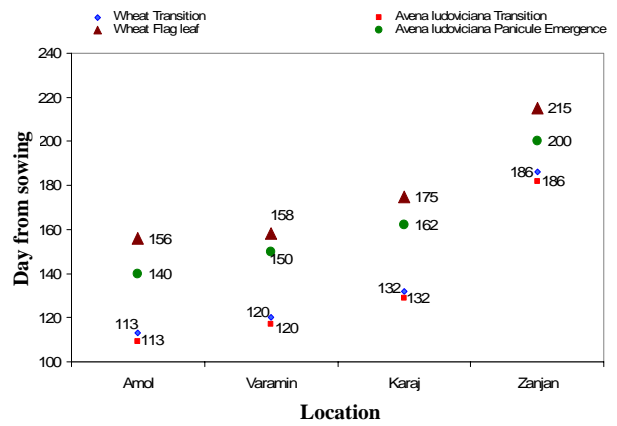
(*A. ludoviciana*)

Fig 7. Comparative phenology of wheat and winter wild oat in reproductive phase based on growing degree days from planting during 2007

Fig 6. Comparative phenology of wheat and winter wild oat in reproductive phase based on number of days from planting during 2007



(A. ludoviciana)



(A. ludoviciana)

Fig. 9. Comparative phenology of wheat and winter wild oat in reproductive phase based on growing degree days from planting during 2008

Fig. 8. Comparative phenology of wheat and winter wild oat in reproductive phase based on number of days from planting during 2008

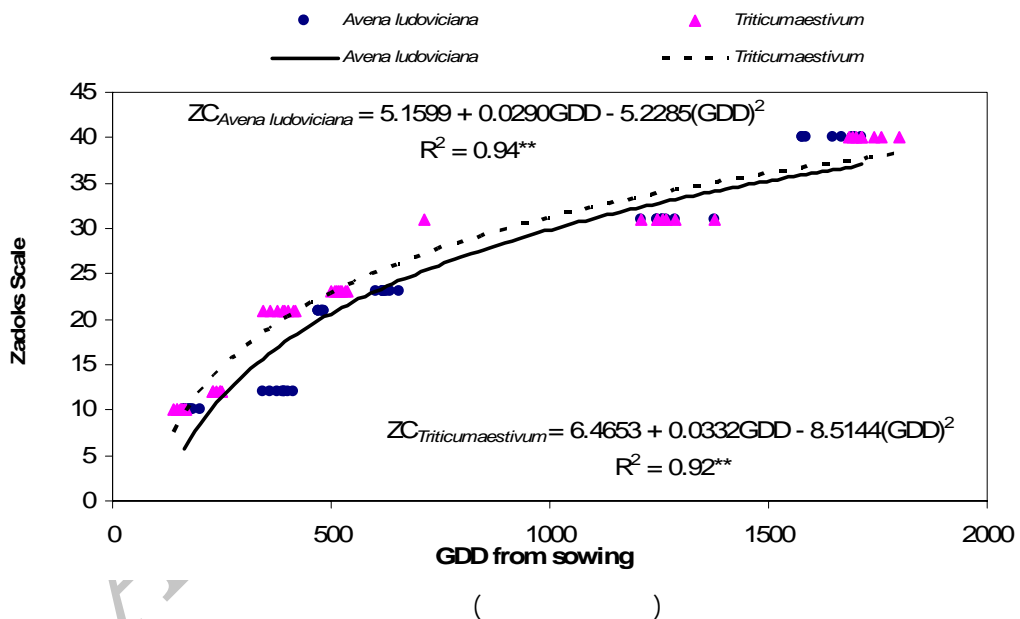


Fig. 10- Regression models to predict growth stages (Zadoks code) of wheat and winter wild oat in relation to growing degree days from planting

Martin et al. (1987)

(*Avena fatua*)

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(Montazeri *et al.*, 2005; Zand *et al.*, 2008)

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Kon *et al.* (2007) .

Holm *et al.* (2000) .

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(Syngenta, 2006)

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(McCoy and Johanston, 2001)

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(Cook *et al.*, 1993; McCoy and Johanston, 2001)

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(Dill *et al.*, 2002)

IDW

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(Gotway *et al.*, 1996)

(Dill *et al.*, 2002; Teuton *et al.*,)

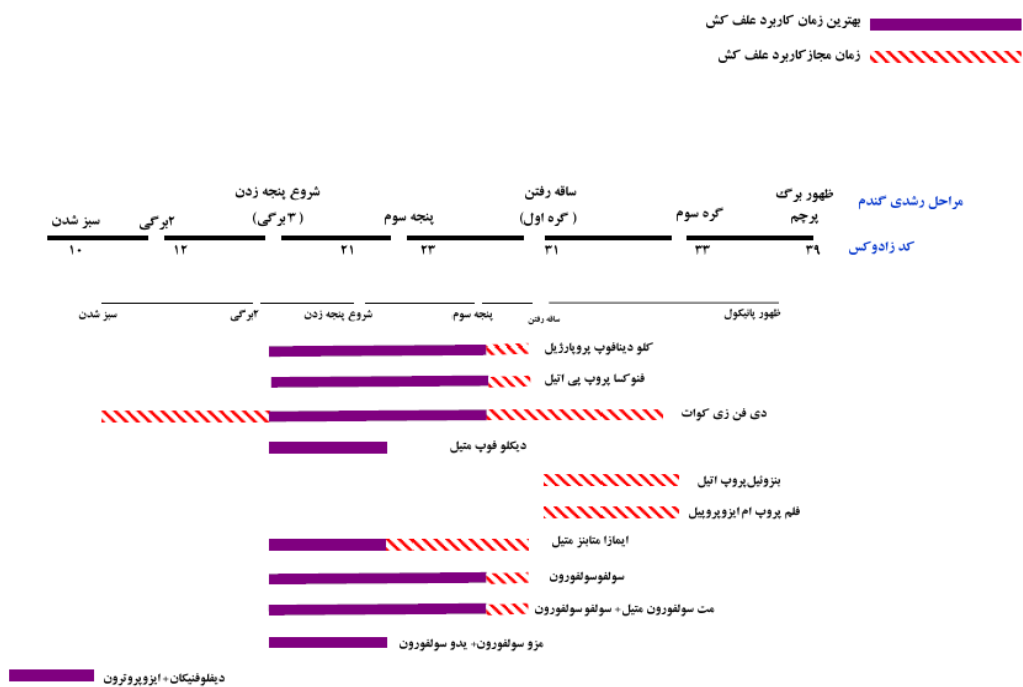
(2005; Main *et al.*, 2004)

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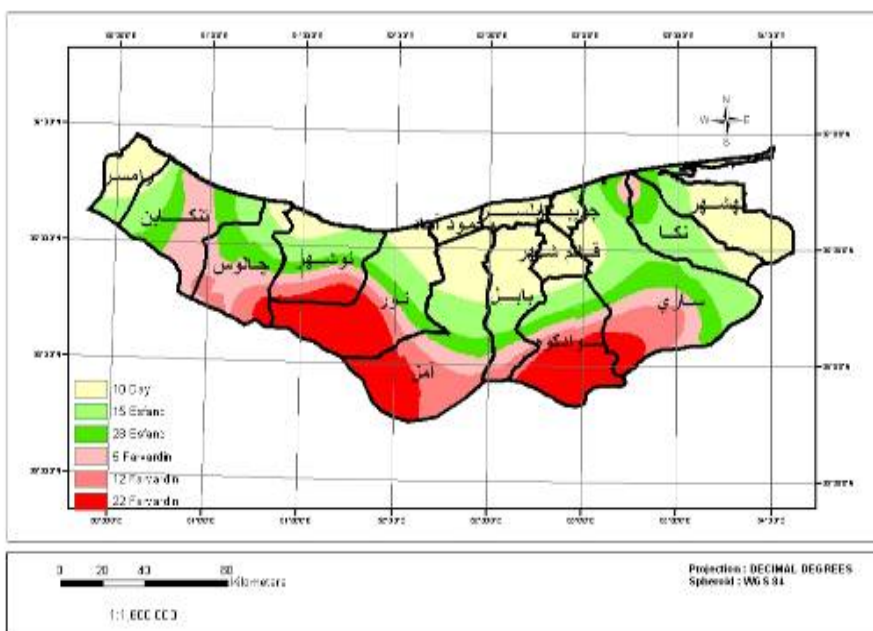
Variography

Semivariograms



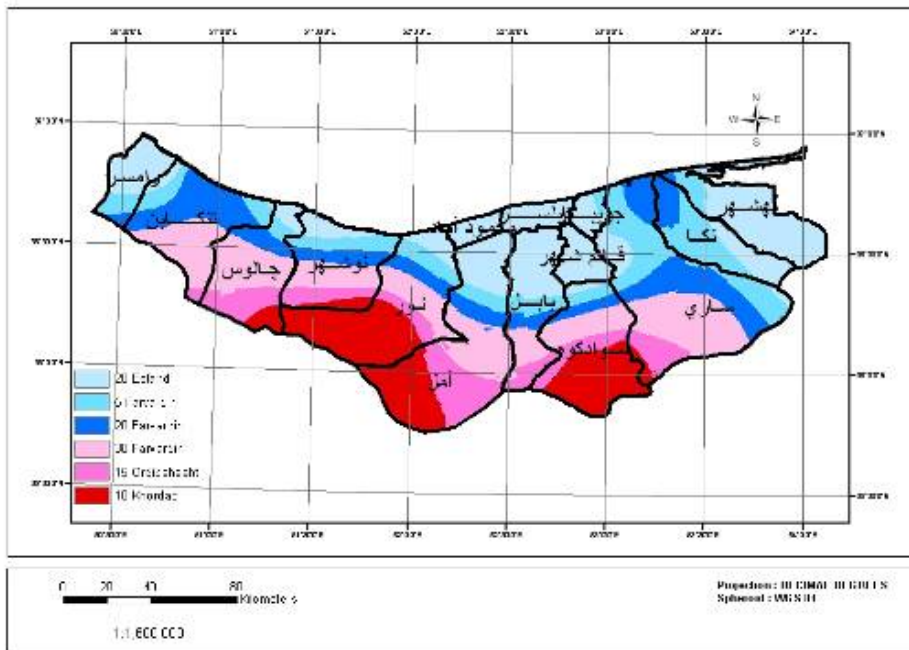
(*A. ludoviciana*)

Fig. 11- Optimum herbicide application time for winter wild oat (*A. ludoviciana*) control based on comparative phenology with wheat

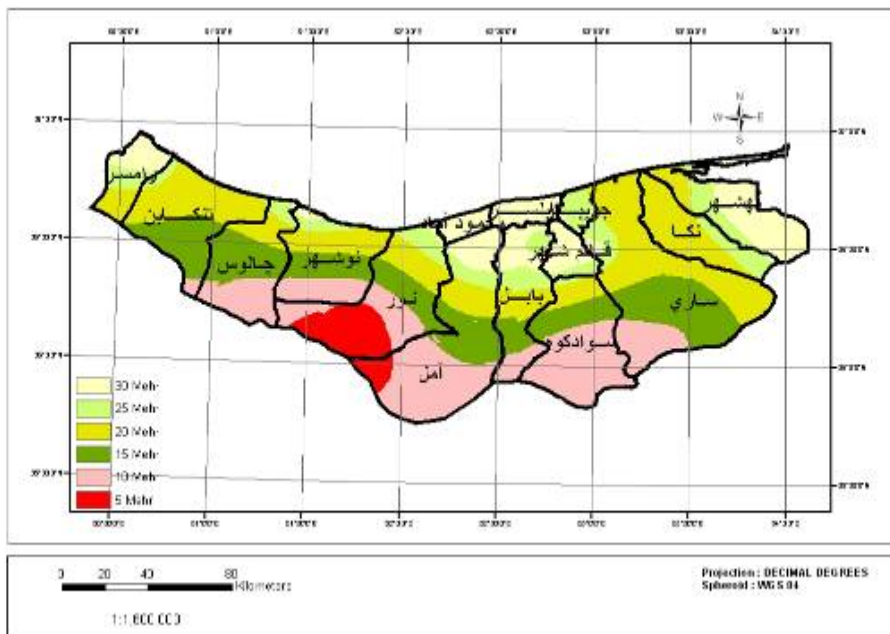


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Fig. 12. Prediction map for the best time to start chemical control (post emergence) of winter wild oat in different regions of Mazandaran province



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Fig. 13. Prediction map for the best time to terminate chemical control of winter wild oat in different regions of Mazandaran province



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Fig. 14. Prediction map for the best time chemical control (pre emergence) of winter wild oat using diflufenican + isoproturon in different regions of Mazandaran province

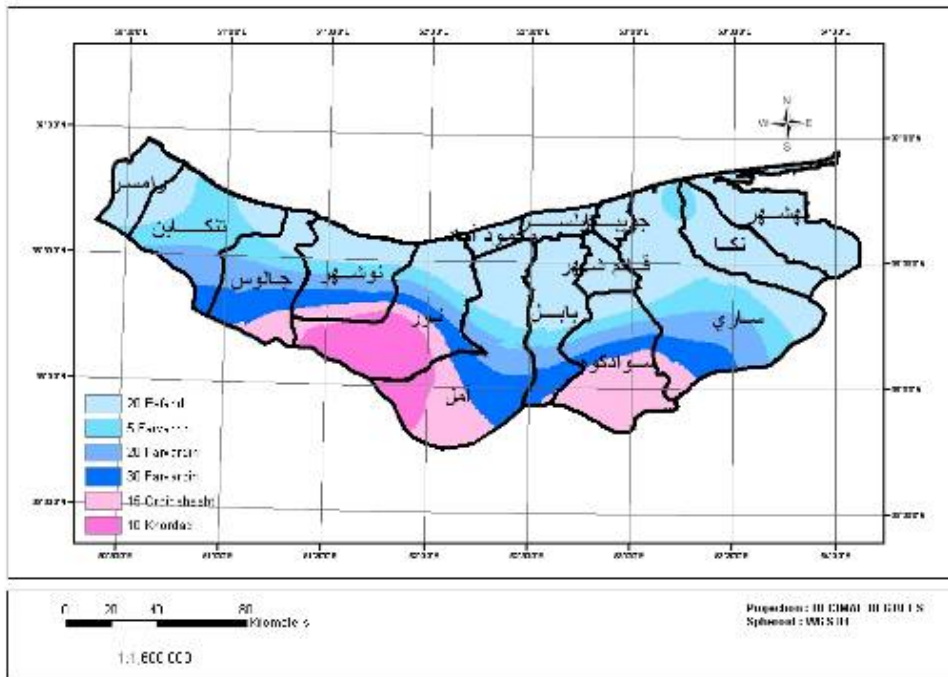


Fig. 15. Prediction map for the best time of nitrogen fertilizer application in order to reduce competitive ability of winter wild oat against wheat in different regions of Mazandaran province

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