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The Radial-growth Variations with Climate Changes in Beech Forest on the Northern of Iran (Case Study: Asalem Region)

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Abstract: *Fagus orientalis*, as climatic specie, is under climatic variable conditions so that climatic elements variations effect directly on its growth and distribution. The purpose of this study was to investigate the relationship between radial growth and climatic parameters variations (temperature and precipitation). The present study was conducted in the Asalem forests, Guilan province which located in northern part of Iran. The 180 sample discs were selected by selective sampling method in three elevation levels with respect to climatic data in 38 year-old period (1966-2003). Results revealed that the growth trend with 7-10 years-old period were different in diameter classes. The growth trend index had no conformity with temperature and precipitation at winter and autumn; however there were conformity with temperature index in small diameter classes and with rainfall index in large diameter classes in the seasons of spring and summer.

Key word: temperature, precipitation, increment, beech oriental, selective sampling, Asalem

INTRODUCTION

The Caspian region is a humid zone in northern Iran with an annual precipitation of between 600 mm in the east and 2000 mm in the west of the region. The *Fagus Orientalis* is the common dominant tree species in northern forest of Iran that it is situated in a belt which lies between 700 and 2000 m a.s.l. (Sagheb-Talebi & Schutz, 2002 and Sagheb-Talebi *et al*., 2004) and due to height, physiological tolerance and competitiveness, it would be the dominant tree species at most of the sites so it covered 17.5% of the surface and accounted 30% of volume (Sagheb-Talebi & Eslami, 2008 and Marvie-Mohadjer, 2005). The *Fagus Orientalis*, as climatic specie, is under climatic variable conditions so that climatic elements variations effect directly on its growth and distribution. Beech growth depends on climatic conditions. Piovesam *et al*. (2005)'s study with respect to diameter increment in beech forest of Apennines zone, Italy indicated that there was significant relationship between the growth trend and annual temperature. Investigation of annual climatic variations on canopy growth at rain forests of Costa Rica by Clark and Clark (1994) showed that there was not any relationship between seven rainy years and growth pattern, although the most growth has occurred in two nearly-dry years. Likewise mature trees have the most reactions to rainy years (Clark and Clark, 1994). Skomarkova *et al*. (2006), studied variability of radial growth and tree-ring structure using beech (Fagus sylvatica L.) from Central Germany (Hainich and Leinefelde site) and Italy (Collelongo). At this study tree-ring width is correlated with the climatic conditions at the beginning of the growing season, maximum density correlates with temperatures. Hoshino *et al*. (2008) analyzed the radial-growth variations of Japanese beech using two site chronologies for the northernmost part of Honshu Island. He found that the raw ring-width series showed abrupt growth depressions at interannual to bidecadal intervals. In addition, the climate–growth response analysis suggested that the optimal growth of Japanese beech largely depends on above-average temperature in the previous summer.

The purpose of this study was to investigate the relationship between radial growth- climatic parameters variations (temperature and precipitation) in northern forest of Iran.

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MATERIAL AND METHODS

Sites of Study:

The present study was conducted in Asalem region, Talesh County, Guilan province, which located in the southwestern part of Caspian Sea. The Asalem region is located between 37 36 00″ N and 37 44 30″ N, 48 36 05″E and 48 56 30″ E. This research carried out in the 1, 2 and 3 districts of Nav forestry design in the beech site of mountainous regions. In order to determine the measure of beach radial growth on the base of environmental and economic regards, we selected samples from 850-1600 m a.s.l.

Method:

From each diameter classes (10 to 105cm) 3 discs were selected from remove trees by using selective sampling method and general characteristics of samples and of site were recorded (north and northwestern direction and 10 to 40% of slope gradient). A total of 180 samples of discs (60 samples in each site) were selected. The data were collected between April until September 2007. To compute annual rings-width were used gauge loop in two directions at a 38 year-old-period (1966-2003). Climate records in this region are provided from two meteorological stations, Kharjegil and Pilambera. To analysis climatic data Z scores were used. The range of Z scores were changed between +4 to -4. This index compared with zero score as a base line, so positive coefficients indicate increasing precipitation and negative coefficients indicate decreasing precipitation rather than mean of the period. Excel software was used to analysis data.

RESULTS AND DISCUSSION

As shown figure 1, increasing trend of growth in 45 cm diameter class had conformity with oscillation trend of precipitation and especially temperature. Increasing trend of temperature and precipitation at 70 cm diameter class had not conformity with growth index in spring, and it has acted inversely. On the other hand, growth trend, especially in the late of the period, were declined by increasing temperature and precipitation. Overall trend of three indexes was positive in the 95cm diameter class; however the increasing periods of growth index had conformity with the decreasing periods of temperature and precipitation. These periods have been repeated in 8-10 years alternatively (Figure 2).

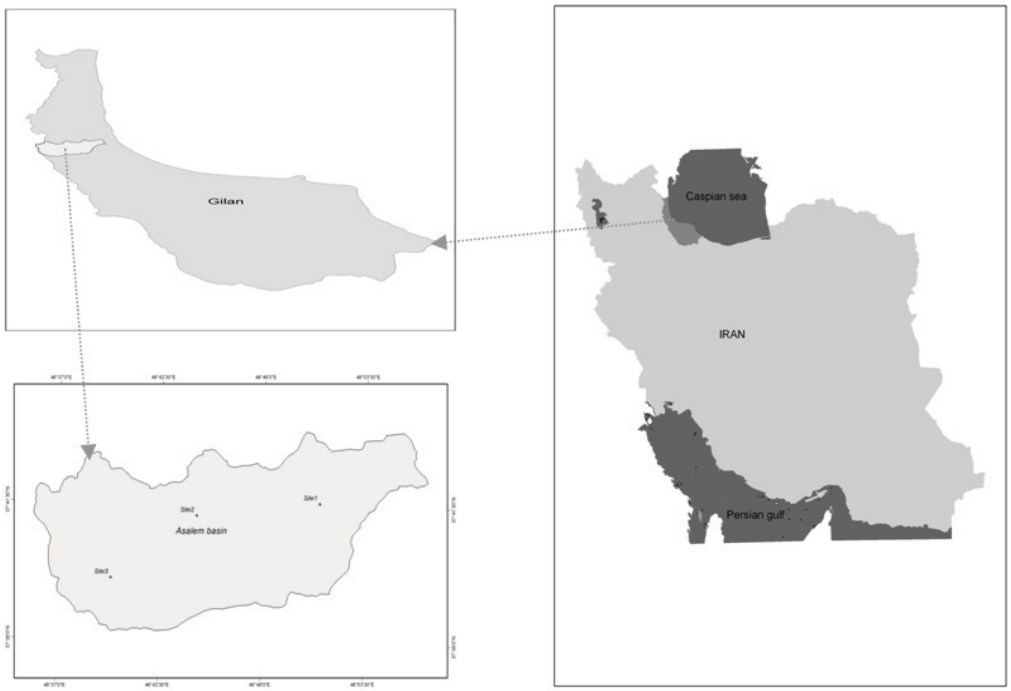

Fig. 1: Site of study

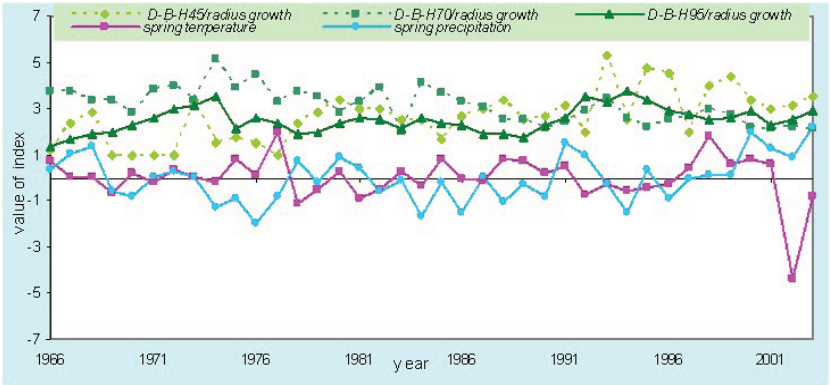

Fig. 2: Relationship between growth, temperature and precipitation indexes in 45, 70 and 95 cm diameter classes (spring)

Investigation of growth index trend in compared to climatic parameters revealed that, the precipitation have increased periodically. Also, temperature had increasing trend too. This trend had agreement with 45cm and 95 cm diameter classes, but trend of these three indexes in 95 cm class had less gradient rather than 45cm class.

Examination of annual radial growth with temperature and precipitation index (1966-2003) indicated that increasing temperature and precipitation index caused to increasing growth index (45-95 cm diameter classes). However, the 70 cm diameter class had inversely reaction with regard to increasing trend of temperature and precipitation (Figure 3). It be concluded that in annually scale, temperature, precipitation and growth index have been increased. Analysis of growth curve with temperature and precipitation index in autumn and winter indicated that there was no any trend between above-mentioned indexes; however there was conformity between increasing trend of growth index and decreasing trend of two parameters in the beginning of period (1966-2003). But after 1974 there weren't any significant trends between them (Figure 4 and 5).

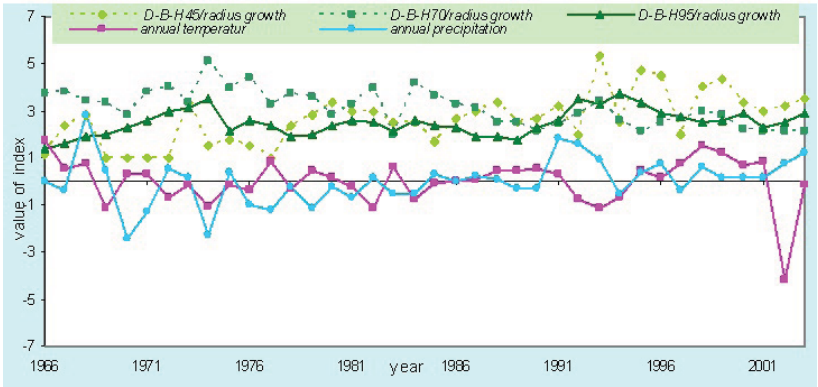

Fig. 3: Relationship between growth, temperature and precipitation indexes in 45, 70 and 95 cm diameter classes (annual)

According to Mir Kazemi and Mir Badian *et al.* (2005)'s study beech has two different seeding period (plentiful period: 3-18 and slight period: 1-5 years) that it could be effected on growth trend. According to affection of climate parameters (precipitation and temperature) on beech species there was not any conformity pointy (year–to-year), while there was logical relation between growth index and climatic parameters in different seasons. Considering to conformity of growth trend with climatic indexes in autumn, in same case there was not any special trend in precipitation and temperature index (Figure 4). There was same trend in winter season too (Figure 5). Increasingly trend of precipitation and temperature index in spring and summer had different effects on growth index in different diameter classes. This mean that by increasing temperature and precipitation, growth index was positive in low diameter class, while this index was negative in medium

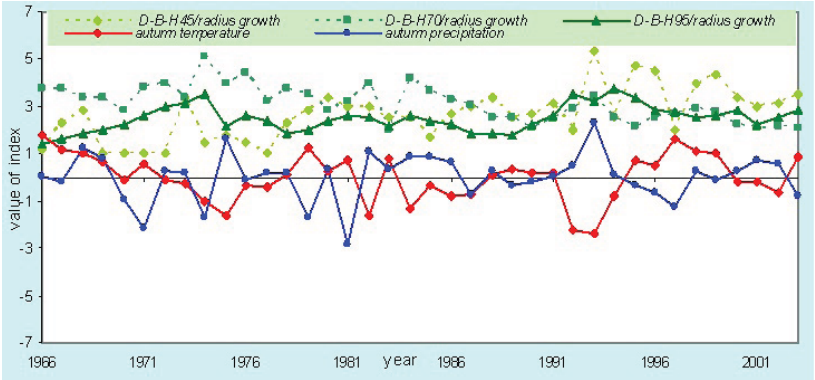

Fig. 4: Relationship between growth, temperature and precipitation indexes in 45, 70 and 95 cm diameter classes (autumn)

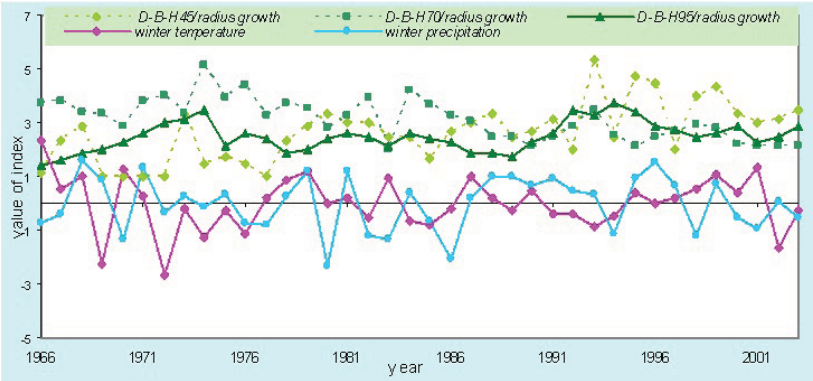

Fig. 5: Relationship between growth, temperature and precipitation indexes in 45, 70 and 95 cm diameter classes (winter)

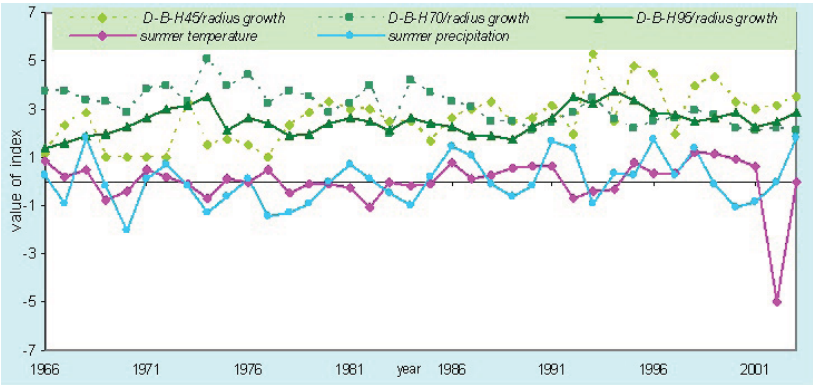

Fig. 6: Relationship between growth, temperature and precipitation indexes in 45, 70 and 95 cm diameter classes (summer)

classes. In high diameter classes, the growth index was positive by soft gradient. In annual scale, this relation is similar to spring and summer seasons (Figure 2 and 6). Sensitive of low diameter classes (lower than 45cm) to temperature and precipitation changes (especially in warm season and annually) is more than high diameter classes (up to 90cm).

In the other word, mature trees had more interaction to climatic variations. In the most cases of pointy analysis there is conformity between temperature and growth index in low diameter classes and between precipitation and growth index in high diameter classes. Increasing of winter precipitation can be caused to

increase growth index in the next year. These results underpin Piovesam *et al*. (2005)'s study in beech forests, Italy. While Garfinkle and Brubaker (1980) reported that there was relationship between diameter growth with temperature in autumn and winter seasons, but there was not the same relationship in the site of this study.

Conclusion:

In order to examine the relationship between growth index and climatic parameters, (temperature and preoipitiation), three samples were selected from each diameter class in three different altitudes (districts 1, 2 and 3). Analysis of growth curves in specific duration (38 years) of study reveal that there is not the same growth trend in the different diameter classes, however diameter classes which were between 10-50 cm had positive growth trend (increasing), and diameter classes between 50-65 cm had no conformity with any special trends (however the maximum annual radial growth was seen in this class). The growth trend was negative in 65-85cm diameter classes and amount of growth have been decreased rather than lower diameters in the period of study. In addition, from 90 cm diameter class is increasing growth trend again, and from 105 cm diameter class is decreasing growth trend again. This finding underpins the multi-growth theory of beach. The important point is that gradient of growth in higher diameter classes was lower than low diameter classes (10-50cm). On the other hand the older trees had higher growth extremes. Totally, growth index in the most of diameter classes had 7 to10 years period growth. It seems that same factors such as plant physiology, productivity, and climate parameters, rooting and seeding are effective factors for it.

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