SHELTERBELT AS A BEST PRACTICE OF IMPROVING AGRICULTURAL PRODUCTION

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Introduction

Shelterbelts and windbreaks being used for protecting fields from wind, increasing productivity and improving the quality of living environment have a long history. In the past seventy years, their distinct effects on the local microclimate have been demonstrated by several investigations carried out through laboratory experiments, full-scale field tests and computer simulation.
This paper presents earlier experiences of the effects of shelterbelts on agricultural production systems and the future prospects in Hungary.

Material and method

In Hungary, large scale field experiments started in the early sixties with the aim to collect and statistically analyse results on agricultural yield measurements. Researchers investigated yield quality and quantity on the 7 most relevant agricultural crops at 18 locations. The tested crops were winter wheat, winter barley, spring barley, alfalfa, maize, carrot, and pasture grass.

Results and conclusions

Based on the results, the following conclusions were reached (Gál,1961, Gál et al., 1963):
Measurements showed the beneficial effect on both sides of shelterbelts, and the highest level of protection was found where forest belts were established perpendicular to the wind direction.
The width of the effect-zone (manifested in the volume of crop yield) is defined by the height and structure of the shelter belt. Differences in width of the belt are not particularly determinative. The largest increase of yields were measured at a distance of 3-10 times tree height.
The more extreme and dry the site conditions are, the more significant was the effect of the shelterbelt on the microclimate and yield volume (**Table 1**). In general, increases in yield of cereals and alfalfa were larger than increases of root crops. This indicates that cereals and alfalfa require more protection under regional climatic conditions than root crops, although recent climate change tendencies presumably have influence on these indicators.
Table 1: Increase in yield varied by species measured in different locations, without crop rotation (Gál et al., 1963)

Crop species	Relative increase in yield (%)
winter wheat	9,8-26,8
winter barley	1,7
spring barley	6,1-33,5
alfalfa	20,3-22
maize	2,9-28,7
carrot	6,2
pasture grass	15,3

In close vicinity of shelter belts (up to 60 m) crop yields were measured to be lower than in the middle of the protected zone. This negative effect can be reduced by doing restructuring cuts in shelterbelts in due time.
In dry years, the difference in crop yields did not vary significantly relative to the distance from the shelterbelts.

Effects of shelterbelts occurred in very different ways varying by places, seasons and weather, site conditions, agricultural technology used and the type of crops, but there are a number of identical conclusions drawn from the measurement results. Literature data (Gál et. al, 1960; Gál,1961; Gál et al., 1963; Gál - Káldy, 1977) clearly demonstrated that:

shelterbelts, especially if they form a coherent system, have a major crop protection and enhancement effect already at a young age;
the yield changes along a gradient, which depends on the effective range of the shelterbelt;

Extremes enhance the intensity of the beneficial effect of shelterbelts on microclimate and yield growth;
Shelterbelt impact largely depends on the sensitivity of the crop to the harmful effects of the wind, the local conditions and environmental / weather conditions;
the approximate 5% yield loss in large lands for agricultural production - caused by the shadow effect and root-competition along the forest belts is more than compensated by the extra yield and better quality crops provided in the protected zone;
The impact of the shelterbelt on crop yields varies not only with the wind speed but also with the structure of the shelterbelt. It was observed that the lower is the wind speed the more reduced is the impact of shelterbelts which have dense structure. Conversely, the effect of shelterbelts of less densed structure is more intense if the wind speed reduces. The greatest effects of wind speed were noted for absolute wind speeds between 0.8 and 6.9 m/s;
There was no evidence that wider shelterbelts provided more crop protection. Therefore the installation of less dense shelterbelts with 10-30% gaps is economically more reasonable for agricultural goals. The width is important however from an ecological point of view as it affects plant and animal species richness by increasing the numbers of ecological niches.
Based on the literature sources (Gál et al., 1963; Danszky, 1972; Gál-Káldy, 1977; Baudry et al., 2000; Marton-Csete, 2004; Láng et al., 2007; Takács – Frank, 2008; Frank - Takács, 2012) and the climate impact tendencies reported by the Directorate General for Regional Policy (Kelemen et al., 2009) the use of shelterbelts is definitely justified, especially in areas with higher than average wind-effects.

The National Rural Development Program envisions the installation of 15,000 hectares of forests and the creation of 1,500 hectares of agroforestry systems. Within the latter, planting of shelterbelts is a newly started measure. The guidelines for the structure and choice of tree species must be taken into consideration during the installation. By the effective use of the available knowledge and financial resources, the total area of shelterbelts could be enhanced and outdated or discontinued belts could be renewed. Together with the initiatives on introducing alley cropping in the lands, the development of shelterbelt systems is an important step forward in improving the climate resilience of domestic agriculture.

In building on earlier research results, new studies become also necessary for the proper development of the Hungarian shelterbelt system. Recent investigation aims at examining the condition, structure and effects of buffer belts older than 50 years. Based on the results of nearly 60 years of extensive research, well-founded design guidelines and strategies can be developed for the most optimal installation of shelterbelts. These surveys are being done by the Institute of Silviculture and Forest Protection of the University of West Hungary.

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