Experiences of plant farm managers regarding climate change in Hajdú-Bihar County

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Abstract

Plant growing in prone to the weather conditions, therefore climate change and extreme weather means a challenge for farms. The authors examined six farms in Hajdú-Bihar County in topics of sowing structure, tillage, sowing, nutrient management, plant protection and precision agriculture. The results shows the technology and machinery changes and experiences of those farms in their plant production. Summarising the answers there were several tendency in the technology changes in the examined farms, many of them related to the climate change of the extreme weather For instance: effort to conserve water, reduce the operation, implementing precision agriculture techniques etc.

Keywords: climate change, plant production, soil preparation, adaptation, technology

Introduction

Climate change is a very complex process, but anthropogenic greenhouse gas (GHG) – mainly carbon dioxide – emission is considered the most important cause. There is an intention among many countries to decrease GHG emission. In the European Union, the goal is to decrease GHG emissions by 40%, compared to 1990 until 2030 (*EC* 2014). Despite the long-term importance and necessity of those GHG reduction measures, climate change has started and its short-term consequences cannot be reversed.

Hungary will be affected as well in the climate change. According to the climate modelling scenarios, the climate around Debrecen in 2040 will be similar to the current climate in North-Serbia, and North-Bulgaria. Which means higher temperature in summer and less precipitation (*Harnos et al.* 2008). The forecast says more probability and frequency for extreme weather and water management situations drought, flood, and those negative effect will be increased (*Várallyay* 2010).

Those scenarios calls the attention for more conscious effort to adapt the plant production technologies to those changes. There is many possibilities in proper tillage to reduce the negative effects of climate change and to sustain the fertility of soils. Stubble must be tilled and rolled a soon as possible. Mulch in a surface reduces the loss of water and the climate risk of end summer sowing. Compaction and open surface make the soil more vulnerable to extreme climatic effects (*Birkás* 2010)

Precision agriculture is a way to both mitigate and adapt to climate change. On the one hand precision agriculture mitigate climate change, because reduce the overlaps – fuel consumption and helps to optimise the use of outputs in the field. On the other hand helps the adaptation by treating the differences in the field according to its need and possibilities and by of auto steering overlap – and excess treading can be reduced. Furthermore 2 centimetre accurate steering – with RTK (Real Time Kinematic) correction – is a requirement for strip tillage.

Materials and methods

In this research six plant production managers has been questioned in North part of Hajdú-Bihar County. The form of examination were oral interviews and document analysis. Those managers were not the top manager of their companies, but those who are responsible for plant production, and/or plant protection. The interviews were anonymous; therefore, in this article those companies are referred to as Farm1, Farm2 etc. The six farm altogether works on 12 000 hectares of arable lands. Grasslands, orchards, vineyards, vegetables out of arable lands, animal husbandry and contract work does not include this study even if the examined companies had such an activities. The individual area of the questioned farms and the exact sowing structure is not indicated in this paper due to anonymity. However, the sowing structure will be indicated in graphs, in percentage values; and animal husbandry is mentioned in those companies where it is relevant because of the connection with arable farming.

The questions of the interviewed covered several topics, which were related to the main steps of plant production. In this study, the main topics are soil preparation, sowing, nutrient management, plant protection, and precision agriculture. Regarding all main topics the question was, what technology they follow, which kind of machinery they use, and what differences they made in the last decade in their technology and how important was the climate change or the volatile weather in that. The aim was to get the viewpoints of those plant production managers regarding the new plant production technologies, the adaptation of the climate change, and their future prospects.

Results and discussion

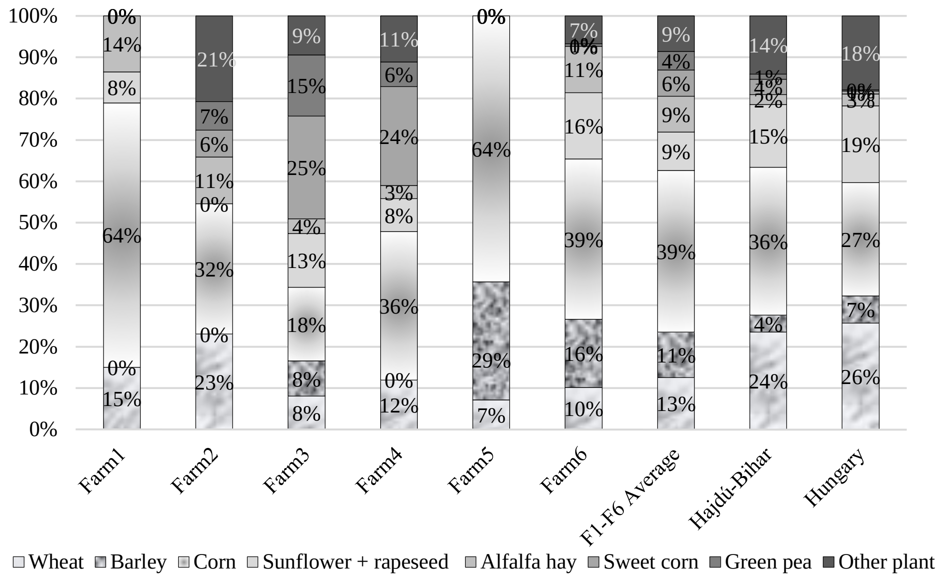
Sowing structure, general data

The examined six farms cover altogether almost 12 thousand hectares of arable lands. *Figure 1* shows the plants in the examined farms, these data had been compared to the county and the national average. The farm data are from the recent year, but statistic data is from year 2014 (and in case of green peas and sweetcorn year 2013), since this is the latest currently available.

The different crop structure in based on different circumstances. All farms have a considerable amount of animal breeding sector. Four of them grow plant for both selling and animal breeding. Farm1, and Farm5 uses all yield for animal breeding, therefore they grow less kind of crops. Farm2, Farm3 and Farm4 has a possibility to irrigate, therefore they grow sweetcorn and green peas as well. Comparing the average values of the examined farms and Hajdú-Bihar County, the tendencies are more or less similar.

Only Farm6 grows rapeseed, other farm considered rapeseed a risky plant mainly because of the lack of adequate precipitation in late summer period, which is essential for germination. However, rapeseed covers only 1.1% or arable land in Hajdú-Bihar County compared to 4.9% Hungarian average (*KSH* 2015).

Figure 1. *The sowing structure of the interviewed farms in 2015*



Sources: farm interview data; (*KSH* 2014, 2015)

Tillage

Facing changeable weather and rain condition all farm managers mentioned that the soil humidity preservation is more important issue than few years before. All farms try to perform harrowing, with rolling at the earliest possible time after harvesting, to minimize water loss in summer period. Five of the farms have modern disc harrow, with short perpendicular frame construction, which include rolls.

Regarding ploughing there is very diverse picture among the questioned farms, but there is a tendency to reduce ploughing. Farm1 uses the conventional harrowing ploughing, seedbed cultivating tillage. In case of Farm2, they use ploughing or mulch cultivator; and the ploughs are equipped with rolls. Farm3 uses sub-soiler and mulch cultivator besides ploughing, when the conditions and the mount of plant residues enables it. Farm4 similarly tries to reduce ploughing, with using mulch cultivator and sub soiling. Furthermore they have some fields in heavy clay conditions – where ploughing is extremely expensive – therefore those fields had no ploughing for more than 10 years.

Farm3 Farm5 and Farm6 started to apply strip tillage in 10–40% of maize area. The experiences are positive. In case of Farm3 the manager mentioned, that in very dry conditions a deeper and more thorough autumn tillage is better, than strip tillage.

Soil compaction is also a negative effect, which can be reduced by proper technology. Farm5 proved to be very conscious about that. During harvesting transporting (heavy goods vehicles (HGV) are banned from the fields, they use instead tractors with chaser bins (which have very wide tyres) to transport seed from combine harvesters to HGV-s to avoid compaction and to enhance productivity of combines. Besides that with the help of RTK technology and auto-steering there is less compaction in headlands by skipping one or two trail row in turning. Moreover, they deflate the tyres of the tractors at the start of tillage work after arriving to the fields.

Sowing

Sowing grains and legumes, the innovative equipment are (semi)direct seed drills, which can perform seedbed preparation and sowing (or fertilizing) in the same time. Except Farm1, and Farm4 all companies have such a seed drill. However, the double disc harrow on the machine has high horse power demand and fuel consumption. Therefore Farm3 and Farm6 prefers to perform the seedbed preparation and sowing with separate machine for winter wheat sowing, which they consider better for work organizing viewpoints.

At summer time, sowing catch crops – like millet, phacelia or mustard – for green manure has a doubtful result. Farm4 purchased a small pneumatic seeder mounted on a disc harrow to cultivate stubble and sow cover crops at the same time; this produces time, fuel consumption and preserves precious water in summertime (*Figure 2*).

Figure 2. *Modern disc harrow with rolls and mounted pneumatic seeder on Farm4*

Sources: author's photo

Corn and sunflower are sown by precision seed drills. All visited farms have a seed drill, with disc coulters loadable with great weight, which keeps the depth of sowing better in compacted soil and in surface covered with mulch. Therefore, most of those precision seed drills in the questioned farms would be capable of (semi)direct sowing or used in strip-tillage system. None applied direct seeding, but there is a tendency, that less effort to reach back and smooth seedbed. Farmers considered that sometimes few plant residues on the surface or bit rugged seedbed (with less operation) could be better for water saving reasons, and the modern precision seed drill make almost no difference in their work under such conditions.

Several manager mentioned, that the often warm and dry springs led to earlier sowing times in case of maize. In some years on Farm2, even the sowing period started at the last days of March.

Nutrient management

Besides the solid acritical fertilizers, Farm2 uses liquid nitrogen fertilizer (UAN), on seedbed cultivator and row cultivators. Their experience is the liquid nitrogen is utilised better mostly in dry springs, therefore it is a way to reduce the rink of changing climate.

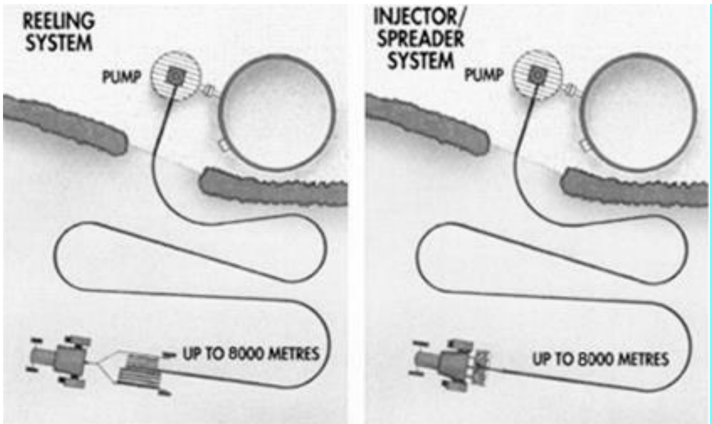
In Farm5 (besides applying slurry), use less intensive nutrient supply in the las few years, because they realized, that in most of their fields water is the limiting factor. They found that the different yields of the different fields mostly correlated to the amount of precipitation in the growing period.

Organic manure is important to return nutrient and organic matter to the fields. Except Farm5 the other farms use their own solid manure. In pork breeding and box system dairy stables slurry is the side-product, which is also utilized in Farm 2, 3, 5, 6. Applying slurry in the fields has several strict regulations and constraints.

In Farm6 they consider slurry distribution is a problematic work, because the on the on hand it helps to reach extra yield from the nutrient but on the other hand there is even a bigger harm which is caused by the heavy slutty spreaders in soil structure (the harm is the biggest in rainy period.)

Farm5 uses an innovative technology for slurry injecting the umbilical pipe slurry system, with a 35 cubic meter tank. The tank and the pump is deployed on the boundary of the field. The tractor drags only the pipe and the injector, the tank is filled with transportation vehicles. This method causes much less compaction, and has a great advantage in fuel saving performance and work organizing. Less is time needed for the same amount of application; smaller tractor with horsepower is enough. This makes easier to avoid wet soil and reduces compaction even more. The concept of umbilical pipe slurry system is visible in *Figure 3*.

Figure 3. *The concept of umbilical slurry system*



Source: *Net1*

Plant protection

Herbicide application in maize had a change from pre-emergent to post-emergent herbicides in the examined farms. Three farms (Farm2, Farm 4, Fam5) uses only post-emergent herbicides in maize. Farm2 and Farm 6 has 30–70% proportion of pre- and post-emergent technologies, and Farm3 uses pre-emergent herbicides only in irrigated fields. The main reasons were uncertain precipitation for pre-emergent technologies, wide range of available post pesticides and small price difference.

Regarding equipment, all interviewed farm except Farm4 and Farm5 have a self-propelled sprayers, because it can be used in high plants and have greater performance than the trailed sprayers.

Mechanical weeding is done by row cultivators in corn maize and sunflower. For strip tillage, different row cultivator is needed, than the conventional sprung hoes. Farm3, Farm5, and Farm6 purchased special row cultivator for strip tillage with rigid shaft.

Precision agriculture

All questioned farms uses at least one element of precision agriculture. The application of precision agriculture technologies on the examined farms are summarised in *Table 1*.

Table 1. *Application of precision agriculture examined farms*

	Farm1	Farm2	Farm3	Farm4	Farm5	Farm6
Precision agr. elements	Yes	Yes	Yes	Yes	Yes	Yes
RTK correction	No	Yes	Yes	No	Yes, own base stations	Yes
Strip tillage	No	No	Yes	No	Yes	Yes
Steering / guidance on tractors	No	No	Auto-steering	Guidance 2 tractors	Auto-steering, several tractors	Auto-steering, 1 tractor
Self-propelled sprayer	Yes	Yes	Yes	No	No	Yes
Sprayer auto-section control	Yes	Yes	Yes	No	Yes	Yes
Variable rate application (VRA)	No	No	No	No	No	No
Other	-	Sprayer auto-steering	Sprayer auto-steering		Seed drill auto row clutch -	-

Note: Farm interviews

Three of the examined farms started to apply auto steering in tractors and two applies auto-steering in self-propelled sprayers. Automatic steering helps to reduce overlap, makes faster the turning in headlands and reduce treading. Automatic steering also helps the drivers to work on poor visibility conditions at night, fog, dust. Night working is important for spraying, Farm2 and Farm3 uses auto steering in self-propelled sprayers to help at night. Strip tillage requires automatic steering with 2 cm accuracy, consequently those farms Farm3, Farm5, and Fam6 has RTK correction with automatic steering in tractors. Farm5 uses RTK base stations instead of subscription.

Farm4 uses guidance monitors on two tractors, helping fertilizing, spraying and tillage its accuracy is about 15–25 cm.

Amount of chemicals can be reduced by automatically closing the unnecessary boom sections in spraying This solution has, greater saving in high working width, therefore each examined farm with self-propelled sprayer purchased this ability. Farm5 uses precision seed drills with row sectioning clutch, according to their experiences it saves about 3 percent of seeds.

Harvesting was not part of the recent study but none of the farm have yield mapping possibilities in combines.

In the field of precision agriculture, the examined farms have further possibilities towards site specific and variable rare application technologies in seeding, fertilisation and plant protection.

Conclusions

- The examined farms are aware of the effects of climate change to agriculture and experienced extreme weather.
- The awareness of water conservation has been raised among visited companies. The farms take more effort to avoid excess operations and soil compaction.
- The importance of ploughing has been decreased, and strip tillage as a new technology has been appeared.
- Climate change was a major reason of changing the maize weeding technology from pre-emergent to the direction of post-emergent herbicides.
- Applying precision farming is a way to optimise the operations and inputs in field. Each farm have started some or more steps in this direction. However, there is much future possibilities in this field towards site specific variable rare application.
- The interviewed farm managers have an innovative thinking and tries to implement the newest technologies – according to the possibilities.

Acknowledgements

The authors thank the managers of the farms for the opportunity of personal interviews, and the data being supplied for this article.

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