Chapter 3.1.

MARKETING OF SUGAR INDUSTRY IN UKRAINE

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1. Tendencies of Market Development of Plant Output

Crop production has always been and remains the main industry of the agricultural sector of Ukraine, which ensures not only food security of the country, but also export of agricultural foodstuff. To provide the population with the produce of both crop and animal origin depends on the development of this industry. There are all necessary conditions: fertile soils, favorable climatic conditions, larger domestic and foreign markets, favorable geopolitical position of Ukraine in the middle of Europe, the availability of seaports, etc. And yet, the dynamic development of crop industry does not provide the population of the country with animal products, which leads to the necessity to balance consumer market through a large part of pork import.

At the same time the production efficiency of crop industry is insufficient. Therefore, external economic activity for Ukrainian producers plays a primary role both in the context of crop production export and its processed output, and import regulation in accordance with the requirements of the World Trade Organization.

It is worth mentioning that those achievements, which are associated with the development of domestic market of plant production output in the conditions of constant transformations, require further research. The search of external segments of the world food markets and the presence of the domestic agricultural products there become more and more important.

In Ukraine in the early 90oties of XX century, during the transition to market relations, the conditions of free pricing were created for all branches of the national economy, and approximately commercial values were introduced for agriculture; they grew much slower than those of goods and services consumed in agriculture, which resulted in price disparity in favor of farmers. This, in turn, affected the structure of sown areas of agricultural crops, namely the increase of industrial crops due to their higher profitability.

Thus a noticeable increase of an industrial crop share in the total sown area of agricultural crops in 2001-2016 was recorded – 13.5% in 2001 to 32.3% в 2016 (*Table 1*) (State Statistics Committee of Ukraine, 2001; State Statistics Committee of Ukraine, 2005; State Statistics Committee of Ukraine, 2015; State Statistics Committee of Ukraine, 2016). Share of industrial crops is increasing in total sown area was due to the expansion of sown areas under sunflower – 9.0% in 2001 to 22.1% in 2016 and the emergence from the 2008 soybeans and rapeseed crops – to 6.9% and 1.7% in 2016 respectively.

The share of grain and leguminous plants decreased – 55.8% in 2001 to 53.6% in 2016. Besides, the share of food crops decreased – 32.8% in 2001 to 24.9% in 2016, while the share of grain forage crops increased – 23.0% in 2001 to 28.7% in 2016.

A considerable decrease of forage crop share – 22.8% in 2001 to 7.2% in 2016 was recorded, which had a negative impact on the development of livestock production in Ukraine. The structure of sown areas remains almost unchanged concerning potato and vegetable and melon crops – 7.9% in 2001 to 6.9% in 2016 (State Statistics Committee of Ukraine, 2001; State Statistics Committee of Ukraine, 2005; State Statistics Committee of Ukraine, 2015; State Statistics Committee of Ukraine, 2016).

Table 1. Structure of agricultural crops sown area in Ukraine by the 2001-2016 (farms of all categories)

Agricultural crop	Structure of sown area by the years, %				
	2001	2005	2014	2015	2016
Grain and leguminous crops including:	55.8	57.6	54.3	54.7	53.6
food	32.8	30.3	24.0	27.2	24.9
wheat (winter and spring)	25.5	25.6	22.3	25.5	23.2
rye (winter and spring)	3.3	2.4	0.7	0.6	0.5
rice	0.1	0.1	0	0.1	0.1
millet	1.3	0.5	0.4	0.4	0.4
buckwheat	2.6	1.6	0.5	0.5	0.6
haricot	0.1	0.1	0.1	0.1	0.1
grain fodder	23.0	27.3	30.3	27.5	28.7
barley (winter and spring)	14.7	17.3	11.1	10.4	10.6
corn	4.6	6.6	17.2	15.2	15.9
oat	2.1	1.8	0.9	0.8	0.8
leguminous (without haricot)	1.4	1.5	0.8	0.9	1.1
sorghum	0.1	0.1	0.3	0.2	0.3
Industrial crops	13.5	20.2	31.0	31.1	32.3
including:					
sunflower	9.0	14.4	19.3	19.0	22.1
sugar beet (factory)	3.5	2.5	1.2	0.9	1.1
soybean	-	-	6.6	8.0	6.9
rapeseed (winter and spring)	-	-	3.2	2.5	1.7
Potatoes and vegetable and melon crops	7.9	7.8	7.0	6.8	6.9
including: potato	5.7	5.8	4.9	4.8	4.9
vegetables	1.8	1.8	1.7	1.6	1.6
Fodder root	22.8	14.4	7.7	7.4	7.2

Source: own research.

Agricultural producers form the structure of their sown areas under the influence of many factors. The main ones are: structure of agricultural lands, their quality, specialization, product demand, and availability of means of production and labor resources, and climatic conditions.

Rational structure of sown areas guarantees the production of the required amount of grain, industrial and forage crops, potatoes, vegetables in a proper range, all crops have good forecrops, and it facilitates the creation of proper agronomic and economic conditions; all this eventually enhances crop capacity. This structure makes it possible to use farm land most efficiently, to create proper crop rotations, as each crop requires a good forecrop. In recent years, the the share of crops which are in great demand has increased (sunflower, corn for grain, soybean), which resulted in the violation of scientifically-grounded crop rotations. A failure to follow crop rotation, a simplified tillage system and plant management caused worsening of phytosanitary state of the fields and, in turn, the increase of pesticide load which affected both the environmental ecology and people's safety.

The socio-economic crisis in Ukraine had a negative impact both on the development of agriculture in general and crop production in particular (*Table 2*) (State Statistics Committee of Ukraine, 2006; State Statistics Committee of Ukraine, 2016).

Table 2. Production of main agricultural crops in Ukraine in 2001-2015 (farms of all categories)

Agricultural crop	Production by years, thousand tons				2015 in % to	
	2001	2005	2014	2015	2001	2014
Grain and leguminous crops including:	39706	38015	63859	60126	151.4	94.2
wheat (winter and spring)	21348	18699	24114	26532	124.3	110.0
rye (winter and spring)	1822.5	1054.2	478.0	391.1	21.5	81.8
rice	68.9	93.0	50.9	62.5	90.7	122.8
millet	266.5	140.6	178.0	213.2	80.0	119.8
buckwheat	387.6	274.7	167.4	128.1	33.0	76.5
barley (winter and spring)	10186	8975.1	9046	8288.4	81.4	91.6
corn	3640.7	7166.6	28497	23328	640.7	81.9
oat	1115.7	790.7	612.5	488.5	43.8	79.8
leguminous	827.3	757.5	481.1	502.1	60.7	104.4
Industrial crops						
including:						
sunflower	2250.6	4706.1	10134	11181	496.8	110.3
sugar beet (factory)	15575	15468	15734	10331	66.3	65.7
soybean	73.9	612.6	3882	3931	5319	101.3
rapeseed (winter and spring)	134.6	284.8	2198	1737.6	1291	79.1
Potatoes and vegetable and melon crops						
including: potato	17344	19462	23693	20839	120.2	88.0
vegetables	5906.8	7295.0	9638	9214.0	156.0	95.6
Fodder root	7712.7	8015.1	6995	6187.5	80.2	88.5

Source: own research.

In Ukraine, in 1990 the production of grain and leguminous crops amounted to 51.0 million tons, then in 2000 it was only 24.4 million tons, so we have a reduction of sugar beet production – from 44.2 million tons in 1990 to 13.2 million tons in 2000, but we see the increase of sunflower production – from 2.5 million tons in 1990 to 3.4 million tons in 2000. And only in later years, grain production was growing rapidly: from 39.7 million tons in 2001 to 60.1 million tons in 2015, or by 51.4%. During this period there was an increase among grain crops, namely, sunflower production – by 6.4 times – up to 23.3 million tons in 2015.

At the same time in 2001-2015 rye production reduced by 78.5% – to 391.1 thousand tons, millet by 20.0% – to 213.2 thousand tons, buckwheat by 67.0% – to 128.1 thousand tons, barley by 18.6% – up to 8288.4 thousand tons, oats by 56.2% – to 488.5 thousand tons, leguminous by 39.3% – to 502.1 thousand tons.

A significant increase in sunflower production is observed – from 2.2 million tons in 2001 to 11.1 million tons in 2015, or by 5 times, soybean by 53.2 times – to 3.9 million tons, rapeseed by 12.9 times – to 1.7 million tons. Potato production is growing dynamically by 20.2% – to 20.8 million tons in 2015 and also vegetables by 56.0% – to 9.2 million tons. Production of fodder root decreases gradually over the years by 19.8% – to 6.1 million tons in 2015 (State Statistics Committee of Ukraine, 2006; State Statistics Committee of Ukraine, 2016).

In this period, the observance of the elements of crop growing technology, the major ones are plant nutrition and plant protection from pests, diseases and weeds along with soil-climatic conditions of Ukraine, ensured the increase of crop yield of the following crops: grain and leguminous crops by 51.7% – to 4.11 t/ha in 2015, in particular of rye on 25.1% – to 2.59 t/ha, rice by 45.9% – to 5.34 t/ha, buckwheat by 49.2% to 1.0 t/ha, corn by 76.2% – to 5.71 t/ha, oat by 16/0% – to 2.32 t/ha, sunflower by 2.3 times – to 2.16 t/ha, sugar beet by2.4 times – to 43.58 t/ha, soybean by 82.2% – to 1.84 t/ha, rape by 2.1 times – to 2.59 t/ha, potato by 49.3% – to 16.14 t/ha, vegetables by 67.3% – to 20.61 t/ha, fodder root crops by 19.6% – to 28.86 t/ha (*Table 3*) (State Statistics Committee of Ukraine, 2006; State Statistics Committee of Ukraine, 2016).

So, in 2001-2015 years the growth in production of some agricultural crops was recorded, due to both their share increase in the total sown area and their yield increase, including: sunflower, soybean, rapeseed. Due to crop capacity increase alone the production of wheat, sugar beet, potatoes and vegetables was increased. The decrease in the production of rye, buckwheat, barley, oats and fodder roots occurred because of the reduction of their share in the total sown area, as well as their productivity decrease.

It should be noted that in recent years grain and leguminous crops have occupied a significant share in the structure of the areas under agricultural crops (2016 – 53.6%), among them are wheat (2016 – 23.2%), barley (2016 – 10.6%), corn (2016 – 15.9%).

On the basis of the polynomial model that describes the level of grain and leguminous crops productivity in Ukraine in 1913-2015, the forecast of their crops capacity was made, and it envisaged its increase (*Fig. 1*).

Thus, in Ukraine there are all preconditions for the increase of the production of grain crops which provide food security as well as export of the produce.

An extensive development of trade relations of Ukraine in the grain market is to be mentioned. The major agri-food products of the Ukrainian export to European Union countries are raw materials of crop production (seed of grain and oil-bearing crops), crude sunflower and other oils.

Table 3. Yield of main agricultural crops in Ukraine in 2001-2015 (farms of all categories)

Agricultural crop	Yield by years, t/ha				2015 in % to	
	2001	2005	2014	2015	2001	2014
Grain and leguminous crops including:	2.71	2.60	4.37	4.11	151.7	94.1
wheat (winter and spring)	3.10	2.85	4.01	3.88	125.2	96.8
rye (winter and spring)	2.07	1.73	2.58	2.59	125.1	100.4
rice	3.66	4.34	5.0	5.34	145.9	106.8
millet	1.06	1.17	1.8	1.89	178.3	105.0
buckwheat	0.67	0.69	1.22	1.0	149.2	82.0
barley (winter and spring)	2.60	2.06	3.01	2.95	113.5	98.0
corn	3.24	4.32	6.16	5.71	176.2	92.7
oat	2.00	1.76	2.51	2.32	116.0	92.4
leguminous	2.01	1.89	2.14	2.04	101.5	95.3
Industrial crops						
including:						
sunflower	0.94	1.28	1.94	2.16	229.8	111.3
sugar beet (factory)	18.26	24.82	47.65	43.58	238.7	91.5
soybean	1.01	1.45	2.16	1.84	182.2	85.2
rapeseed (winter and spring)	1.24	1.46	2.54	2.59	208.9	102.0
Potatoes and vegetable and melon crops						
including: potato	10.81	12.84	17.64	16.14	149.3	91.5
vegetables	12.32	15.71	20.78	20.61	167.3	99.2
Fodder root	24.12	27.31	32.29	28.86	119.6	89.4

Source: own research.

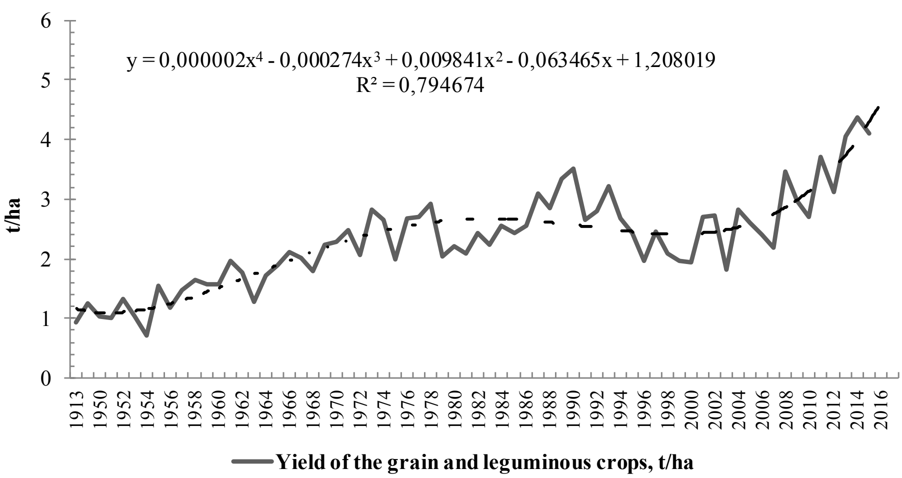

Fig. 1. The dynamics of the grain and leguminous crops yields in Ukraine by years

Source: own research.

Taking into account a favorable condition of external markets and price advance, farm producers increase their sown areas under industrial crops in Ukraine. In particular, a high profitability level of sunflower, soybean and rapeseed encourages producers to increase the sown areas under these crops, compared with those under other crops (*Table 4*) (State Statistics Committee of Ukraine, 2009; State Statistics Committee of Ukraine, 2011; State Statistics Committee of Ukraine, 2013; State Statistics Committee of Ukraine, 2014; State Statistics Committee of Ukraine, 2015; State Statistics Committee of Ukraine, 2016).

Table 4. Economic efficiency of main agricultural crop production in Ukraine in 2008-2015 (agricultural enterprises)

Agricultural crop	Level of profitability, %					
	2008	2010	2012	2013	2014	2015
Wheat	17.6	9.6	11.8	2.4	28.0	36.4
Barley	19.8	-0.4	11.4	0.6	18.3	28.3
Corn	10.6	29.9	19.8	1.5	26.2	50.3
Seeds of sunflower	18.4	64.7	45.8	28.5	36.5	80.5
Sugar beets	7.1	16.7	15.7	2.7	17.9	28.2
Soybean	1.3	16.4	23.4	15.8	34.5	38.6
Rapeseed	51.3	26.6	21.4	8.6	29.2	44.3
Potatoes	7.9	62.1	-21.5	23.0	9.2	24.2

Source: own research.

As it can be seen from *Table 4*, the level of production profitability of sunflower seed increased from 18.4% in 2008 to 80.5% in 2015. During the same period the productivity level increased, as follows: soybean – from 1.3% to 38.6%, sugar beet – from 7.1% to 28.2%, corn – from 10.6% to 50.3%, wheat – from 17.6% to 36.4%, barley – from 19.8% to 28.3%, potatoes – from 7.9% to 24.2%, %, and on the contrary, the profitability level of rapeseed decreased from 51.3% to 44.3%.

In 2012-2013, the reason of the loss of grain industry efficiency is a poor development of agrarian market and infrastructure of grain sale, the lack of an effective mechanism of state regulation of grain produce pricing in the conditions of both grain overproduction and harvest failure, a high level of credit rates and an inadequate budget support of the branch. Presently, government regulation of the grain market in Ukraine does not play a stimulating role as to grain production and it cannot respond effectively to the challenges of the global economy.

It is advisable to work out and apply the efficient mechanisms of crop market regulation on a national level. To stabilize prices of the output of crop production, the government has to apply purchasing and commodity interventions, to coordinate and adjust the pricing policy in the national and international markets.

The orientation of the Ukrainian export on raw materials makes Ukraine's positions vulnerable in foreign markets, as the demand for them is not stable and it is characterized with considerable price variability.

It should be stated that in Ukraine export of grain crops increases and the largest import share from the EU is meat and by-products, this tendency can have a negative effect on the development of the domestic livestock industry in the future.

Hence, the main directions of the enhancement of crop production adaptability in current conditions are: to place agricultural crop fields in favorable soil and climatic conditions, to develop cultivars and hybrids, adapted to the natural conditions of Ukraine, to transfer crop production to post-industrial development models, to provide raw material base for the development of bioenergy, to create forage base for livestock production, to develop organic production, to structure a crop produce market.

To achieve these goals it is necessary to solve the issue of soil fertility improvement by taking a set of organizational-technological measures, namely: to use scientifically-grounded crop rotation in crop production; to focus on organic fertilization systems; to increase the efficiency by using mineral fertilizers via optimization of their doses, terms and methods of application into the soil; to introduce soil-protective technologies; to reduce a negative impact of chemicals on a plant itself and on useful microflora of the soil.

To provide arable farming with adapted cultivars and hybrids of agricultural crops which have higher productivity and ecological resistance to the environmental conditions, it is required to organize seed breeding system of agricultural crops in Ukraine. And yet, the varieties and hybrids adapted to weather and environmental conditions cannot always guarantee the high productivity of agricultural crops because of the process of global warming on our planet.

The application of post-industrial models of crop production development envisages the creation and implementation of: resource-saving bioadaptive technologies of agricultural crop cultivation, integrated pest management, optimization methods of the processes of growth and development of plants, taking into consideration climate changes and principles of precision farming.

In the conditions of the aggravation of the situation in the country which concerns the supply of energy carriers at affordable prices, it is expedient to speed up the production of alternative fuels, in particular those produced from crop output. The manufacture and use of biofuels will accelerate the solution of such strategic goals for the development of Ukraine and agriculture in particular as lesser dependence of the producers on imported fuel and satisfaction of demand for these products at a lower price. Therefore it is necessary to ensure appropriate raw material base for bioenergy development, i.e., to optimize rape sown areas to produce biodiesel and those under sugar beet to manufacture bioethanol. The production and use of bioethanol and biodiesel will make it possible to manufacture ecologically-friendly alternative fuel, to create new jobs, to increase companies' revenues, and to reduce Ukraine's dependence on fuel import.

To improve the structure of crop production it is necessary to manufacture the produce which is in great demand in the world market – wheat, corn, barley, and to optimize the sown areas of sunflower (not more than 15% in crop rotation) – to manufacture oil for domestic consumption and for export, rapeseed – to produce biodiesel, sugar beet – to produce bioethanol, corn for silage, soybean and perennial grasses – to meet the needs of livestock production in proper fodder supplies.

2. Ways of increasing sugar beet productivity

Sugar beet productivity depends on both soil-climate conditions of their cultivation and agro-technological conditions, and first of all, the introduction of highly-productive hybrids, the use of quality seeds, updated machinery and technologies, fertilizers, reliable pest management, highly-technological processing at sugar-mills.

Sugar beet productivity is a function of a complicated interaction of natural and agro-economical factors. The researches done in Germany (Glevaskiy, Kravchenko & Poechalo), prove that among the factors which influence sugar beet productivity over 50% do not depend on people, 34% depend on the year conditions, 17% depend on the location of growing. The effect of agrotechnological measures (plant density, nitrogen fertilization, sowing and harvesting terms) constitutes 35%, and that of the variety is 14%.

If to consider separately a variety (genetic potential) and seeds (their quality), the effect of these factors on sugar beet productivity is equal (50% – a variety, 50% – seed quality), according to the research results of the Institute of bio-energetic crops and sugar beets. When agro-climatic conditions are favorable, advanced cultivation technologies of sugar beets ensure high and stable yields, and seed quality plays an important role. Due to quality pre-sowing seed preparation, using protective-stimulating substances, it is possible to receive additional 10-20% of sugar beet yield (Yunusov, 2000).

Some indicators of crop productivity are known to have genetic basis. The degree of variety or hybrid potential identification is determined by genetic information, which is in a cell, and environmental conditions where plants grow (Ovcharov, 1973).

It is possible to form a large mass of organic substance, including sugar, when vegetation period is long enough, light and temperature regimes are good, soil moisture content and seed quality are high (Helemsky, 1967).

Intensive mass increase of leaves and roots as well as sugar content of biological forms of sugar beets together with soil-climate conditions made it possible to receive the best maximal crop. To estimate climatic conditions according to air temperature and moisture supply, hydrothermal coefficient, which characterizes weather conditions taking into account air temperature and the amount of precipitation for a particular period, is used (HTC). It was established, when moisture content was too high (HTC= 1.2) sugar beet yield and sugar content of both biological forms of sugar beets decreased considerably (*Table 5*).

Table 5. Sugar beet biological form productivity depending on hydrothermal conditions

Year	GTK	Biological forms					
		Diploids			Triploids		
		Yield, t/ha	Sugar content, %	Yield of sugar, t/ha	Yield, t/ha	Sugar content, %	Yield of sugar, t/ha
2010	1.0	62.7	15.1	9.5	60.9	14.9	9.1
2011	1.0	57.8	15.8	9.1	58.1	15.6	9.1
2012	1.2	53.1	15.0	8.0	55.7	15.2	8.5
Average		57.9	15.3	8.9	58.2	15.2	8.9
$LSD_{05\ year\ conditions}$		0.98	0.15	0.16	0.98	0.15	0.16
$LSD_{05\ biological\ forms}$		0.76	0.12	0.13	0.76	0.12	0.13

Source: own research.

A significant difference in biological forms of sugar beets was not seen. The difference in the yield of diploid and triploid forms of sugar beets was 0.40 t/ha ($HIP_{05\ biological\ forms}$ = 0.76). The effect share of biological forms on root yield was small – only 6%, that of the year conditions was higher – 13%.

Summing up meteorological conditions occurred in the years of the research it may be stated that the deviation of several indicators (temperature, precipitation amount, air relative humidity) from long-term average ones did not come close to critical indicators, which in general facilitated to receive high yields of sugar beets. The reserves of productive moisture together with precipitation during the vegetative period, provided they are used rationally, can guarantee root yield equal to 51.1-55.7 t/ha.

The important way to increase sugar beet productivity is to create optimal plant density. It is very important to form steady plant density because both sugar beet yield and sugar yield depend on it. When plants are evenly located in the rows and plant density is optimal, roots of the same size and with smaller deviations from the axe line of a row and soil surface are formed; this in turn allows better mechanized harvesting.

It is worth mentioning that within four years on the average the variations of actual plant density from a planned one were not significant (*Table 6*).

Table 6. Sugar beet productivity depending on plant density, 2010–2014

Variant – plants density, thousand / ha		Yield, t/ha	Sugar content, %	Yield of sugar, t/ha
Accordint to scheme	actual			
80–90	82.7	51.1	14,7	7,5
91–100 – control	94.7	51.9	14,9	7,7
101–110	104.8	55.7	15,1	8,4
111–120	114.0	50.1	15,3	7,7
121–135	126.8	44.3	15,5	6,9
136–145	139.4	41.8	15,8	6,6
$LSD_{05\ year\ conditions}$	1.32	1.41	0,18	0,23
$LSD_{05\ density}$	1.62	1.72	0,22	0,29
$LSD_{05\ year\ conditions/density}$	3.24	3.45	0,44	0,57

Source: own research.

According to the research results, the highest indicator of pure productivity was in the variant with plant density 101-110 th/ha – 5.0 g of dry matter/m^2 of leaf surface per 24 hours, which made it possible to receive the highest sugar beet yield – 55.7 t/ha and sugar yield – 8.4 t/ha.

This is due to the fact that this plant density is close to an optimal one which ensures the formation of proper amount of leaf mass; a leaf area increases, photosynthetic planting potential grows, which results in organic substance accumulation and the outflow of photosynthesis products to the roots.

As the plant density increased to 136-145 th/ha, root yield decreased considerably – 10.1 th/ha, compared with the control, and on the contrary, sugar content increased from 14.9 % (control) to 15.8 % in the variant with density 136-145 th/ha. However, the increase of sugar content with such yield decrease did not give serious sugar yield increase per hectare, both compared with the control and the variant with plant density 101-110 th/ha. For instance, when plant density before harvest was 91-100 th/ha, sugar yield was 7.7 t/ha, when it was 136-145 th/ha, then sugar yield was 6.6 t/ha. Sugar content depended on rather the year conditions than the plant density. Precise estimation of the efficiency of various plant densities can be done using cluster analysis (*Fig. 2*).

To make it, we used such economic-valuable signs as root yield, sugar content, sugar yield, pre-harvest density. Based on the received data of Euclid distances we built a tree of hierarchic clustering.

In the *Fig. 2* we can classify two groups of clusters, namely: I – 101-110, 111-120 th/ha, and II – 121-135, 136-145 th/ha. The combination of the studied density variants in these very groups of clusters proves that sugar beets are better adapted to dense plantations than to thin ones. Thus, higher plant density in the sugar beet fields can provide proper productivity level, but plantations with density 80-100 th/ha cannot guarantee stable productivity. In such fields plants depend more on the effect of unfavorable environmental factors, and weeds affect them immensely, all this explains the difference in main productivity elements and the location of nutrition areas 80-90 and 91-100 th/ha beyond clusters.

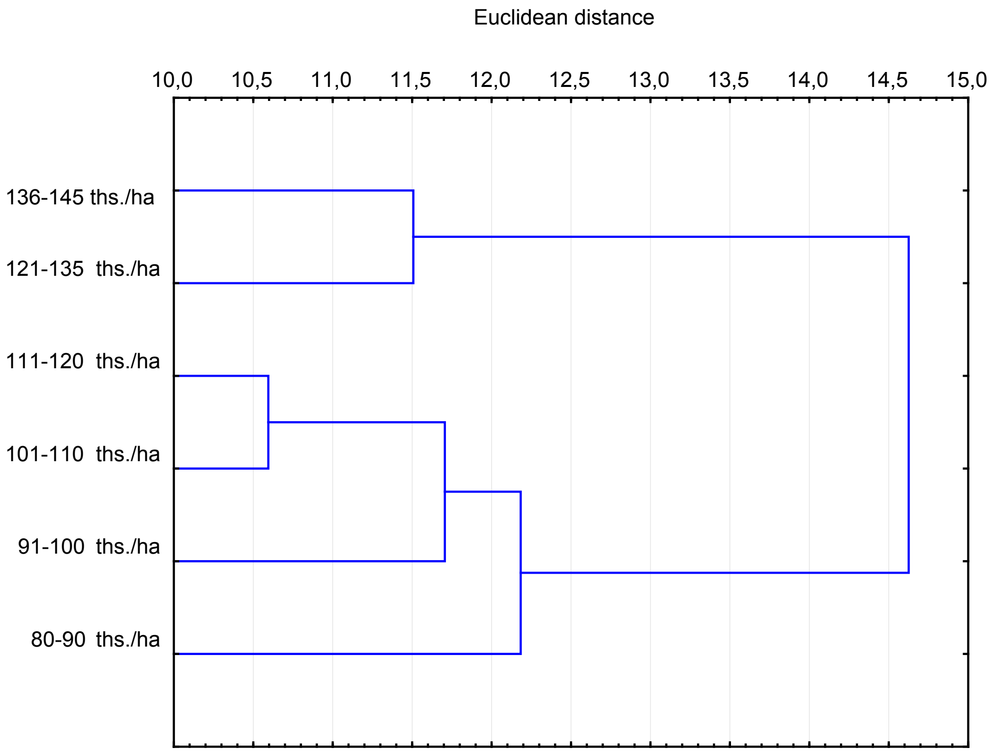

Fig. 2. **Cluster analysis for complex agronomic signs depending on plant density (Umanskyi ChS 97 hybrid)**

Source: own research.

The next important step in increasing the crop productivity is the indicator which characterizes the efficiency of microelement use in the production technology of sugar beets, namely the yield level (Sabluk et al., 2011; Ivaschenko, 1994).

Foliar application with various micro-fertilizers (helaty) is efficient both when spraying is done at the stage of leaf closing in the rows and when leaves close in the inter-rows.

A significant increase of yield and sugar content resulted from the use of microelements is due to the fact that plants need more nutritious elements which are in macro- and micro fertilizers. Hence, foliar application with microelements favors intensification of growth processes, intensive absorption of mobile compounds of macro- and microelements from the soil and fertilizers, which eventually leads to a considerable increase of sugar beet productivity.

It has been found out that the formation of the sugar beet yield, sugar content and sugar yield depend on foliar application at corresponding stages of their vegetation, forms of microelements and their application rates (*Table 7*).

Table 7. Sugar beet productivity depending on terms, types and norms of microelements application in feeding, 2010-2012

Variant – species of microelements (Factor B)	Application rate, l/ha (Factor C)	Plants density before harvesting, thousand/ha	Yield, t/ha	Sugar content, %	Yield of sugar, t/ha
I term: closing leaves in a row phase (Factor A)					
Without feeding (control)	–	97.8	46.3	15.3	7.1
Reacom-R-beet (standard)	5.0	102.5	51.8	14.8	7.7
Reastim-humus-beet	3.0	102.4	49.5	14.4	7.1
	5.0	102.4	52.3	14.5	7.6
	7.0	102.5	56.5	14.5	8.2
Reacom-plus-beet	3.0	101.9	48.5	14.2	6.9
	5.0	102.2	53.2	14.4	7.7
	7.0	103.4	58.0	14.3	8.3
II term: closing leaves between rows phase (136 days from sowing) (Facror A)					
Without feeding (control)	–	98.7	47.4	15.4	7.3
Reacom-R-beet (standard)	5.0	102.9	52.6	14.7	7.7
Reastim-humus-beet	3.0	102.5	49.7	14.3	7.1
	5.0	103.4	56.3	14.5	8.2
	7.0	104.4	64.6	14.2	9.2
Reacom-plus-beet	3.0	104.9	54.4	14.7	8.0
	5.0	105.6	63.9	14.4	9.2
	7.0	107.3	71.2	14.4	10.3
$LSD_{05\ year\ conditions}$		0.61	1.28	0.11	0.20
$LSD_{05\ introduction\ term\ (factor\ A)}$		0.50	1.04	0.09	0.17
$LSD_{05\ type\ of\ fertilizer\ (factor\ B)}$		0.50	1.04	0.09	0.17
$LSD_{05\ application\ rate\ (factor\ C)}$		0.61	1.28	0.11	0.20
$LSD_{05\ interaction\ of\ factors\ (1*2*3*4)}$		2.21	4.42	0.37	0.71

Source: own research.

The types of micro fertilizers influenced sugar beet yield.

Thus, with foliar application at the stage of leaf closing in the row, micro fertilizer Reacom--plus-beet ensured real yield increase compared with both the control and other micro fertilizers. When micro fertilizers were applied at the stage of leaf closing in the inter-row (136 days after sowing), significant yield increase was received with the use of Reacom-plus-beet and Reastim--humus-beet compared with the control and the standard. The highest yield increase was recorded when micro fertilizer Reacom-plus-beet was used at both foliar application terms. At the stage of leaf closing in the inter-rows (136 days after sowing) and the application rate 7 l/ha, this micro fertilizer gave the highest root yield 71.2 t/ha, sugar content 14.4% and sugar yield 10.3 t/ha with the same density of evenly located plants in the row and on the main fertilizer background.

The use of new micro fertilizers Reacom-plus-beet and Reastim-humus-beet on the background of main fertilizer resulted in a considerable increase of sugar beet productivity not only comparing to the control, but also to the application of micro fertilizer Reacom--plus-beet (the standard). This can be explained by the composition of microelements which have a positive impact on plant growth and development and organic mass accumulation.

Sugar beet yield along with other agrotechnical measures depends on the introduction of highly productive hybrids to a great extent.

Based on the research results of the productivity of triploid hybrids of local selection Umanskyi ChS 97 and foreign selection Oriks, pre-harvest plant density of both hybrids was optimal for this area, namely, hybrid Umanskyi CHS 97 – from 96.6 (the control) to 107.67 th/ha (microelements were applied twice), Oriks – from 96.5 th/ha on the control to 107.6 th/ha (micro fertilizers were applied twice).

Table 8. **Sugar beet hybrid productivity depending on terms of microelement application in feeding, 2010–2014**

Variant – term of microelements introduction (factor B)	Yield, t/ha	Sugar content, %	Yield of sugar, t/ha
Umanskyy ChS 97 (Factor A)			
Without feeding – control	43.4	15.3	6.6
Closing leaves in a row phase	47.1	15.1	7.1
Closing leaves between rows phase (136 days from sowing)	49.3	15.3	7.5
Closing leaves in a row phase + closing leaves between rows phase (136 days from sowing)	59.4	15.4	9.1
Oriks (Factor A)			
Without feeding – control	46.2	15.1	7.0
Closing leaves in a row phase	48.6	15.2	7.4
Closing leaves between rows phase (136 days from sowing)	50.1	15.3	7.7
Closing leaves in a row phase + closing leaves between rows phase (136 days from sowing)	61.5	15.4	9.4
$LSD_{05\ year\ conditions}$	1.47	0.10	0.22
$LSD_{05\ hybrid\ (factor\ A)}$	1.04	0.07	0.16
$LSD_{05\ feeding\ (factor\ B)}$	1.47	0.10	0.22
$LSD_{05\ interaction\ of\ factors\ (1*2*3)}$	4.15	0.29	0.63

Source: own research.

The optimal plant density and their steady location along with soil-climate conditions and farm practices helped receive good sugar beet yield – 43.4-61.5 t/ha depending on foliar application terms of triploid hybrids of local and foreign selection (*Table 8*).

In the trials the productivity was associated with genotype expression.

A significant sugar beet yield increase of triploid hybrids with foliar application was recorded regardless of their origin, compared with the control. Thus, when microelements were applied at a leaf closing stage in the inter-rows (136 days after sowing), sugar beet yield of hybrid Umanskyi CHS 97 was 48.9 t/ha and that of Oriks – 49.5 t/ha.

The yield increase of both sugar beet hybrids ranged from 3.9 to 6.4 t/ha (HIP_{05} = 3.9 t/ha), compared with the control. Hybrid Oriks showed the highest yield – 62.8 t/ha when foliar application was done twice, the increase amounted to 17.2 t/ha, compared with the control.

The share of foliar application effect on the root yield was the highest – 53%. The year conditions had a serious effect on the yield – 16%, the effect share of the interaction of the factors "year conditions and foliar application" was equal to 17%. The effect of other factors was not significant.

The results of a cluster analysis proved that trial variants with two-time foliar application of sugar beets (7 and 8) of both hybrids were combined in one cluster (*Fig. 3*).

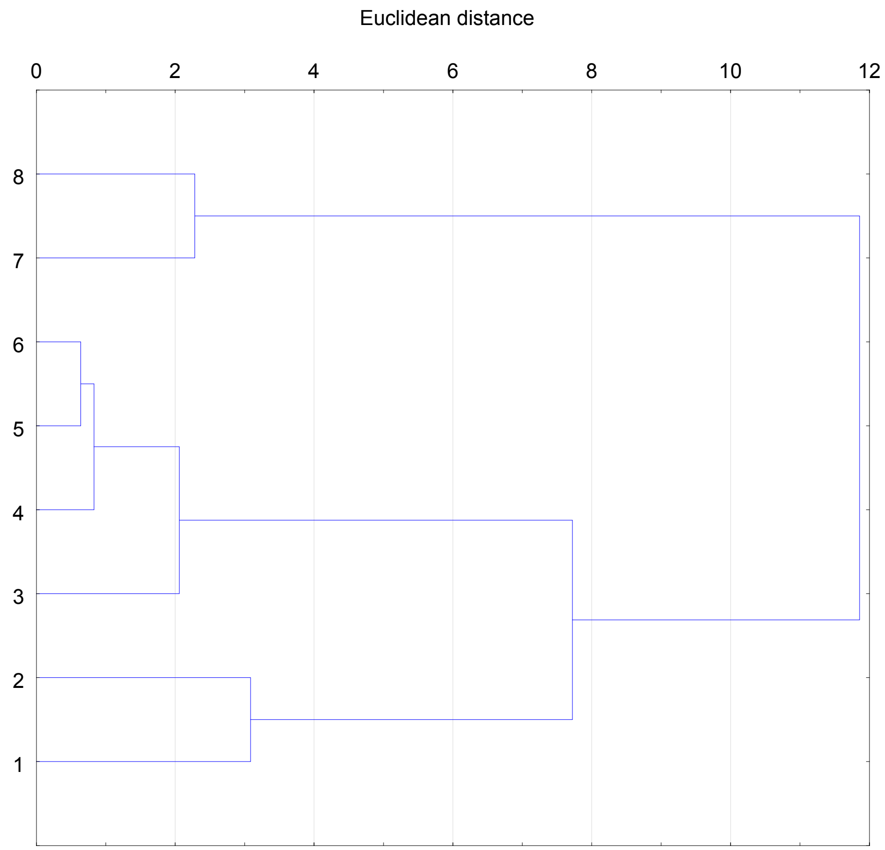

Fig. 3. **Cluster analysis for complex agronomic signs depending on microelement application and varietal composition**

Source: own research.

This combination of variants in one cluster confirms the conclusion that it is expedient to do two-time foliar application which facilitates the highest beet yield of both hybrids. Control variants (1 and 2) of both hybrids with the lowest yield were combined in another cluster, and still another cluster contained variants of both hybrids with one-time foliar application. This proves the fact that despite the origin of hybrids only foliar application influences the yield.

No significant increase of root sugar content in correlation with the terms of microelement application of both hybrids was recorded.

In the experimental years, sugar content ranged from 15.1% to 15.4% on the average. No significant variation of this indicator depending on the varietal composition was recorded.

As the most intensive sugar accumulation in roots occurs in July-September, it is better to do microelement foliar application at leaf closing stages in the rows and in the inter-rows (136 days after sowing), this will favor the outflow of nutrients from leaves to roots, and the increase of root and sugar yield per 1 ha.

Due to the increase of the root yield, and in particular, two-time foliar application with microelements at leaf closing stages in the rows (136 days after sowing) and in the inter-rows (136 days after sowing), sugar yield of both hybrids increased considerably. As the yield of hybrid Oriks, compared with hybrid Umanskyi ChS 97 was higher, the sugar yield per hectare was also higher. The sugar yield per hectare of hybrid Umanskyi CHS 97 was 6.6-9.0 t/ha, whereas that of hybrid Oriks was 7.0 to 9.4 t/ha. In addition, the highest sugar yield of both hybrids was received with two-time foliar application with microelements. Foliar application had the most significant effect which amounted to 56%. The effect of year conditions was 14%, and the interaction of these two factors was 17%. The effect of other factors was irrelevant.

Besides, agro technological measures, an important way of increasing sugar beet productivity, have to be aimed at the creation of favorable conditions for plant growth and development to receive maximal possible genetic potential of hybrid; this, first of all, can be achieved by using high-quality seeds of new hybrids, which, in combination with other factors, ensures high field germination, optimal density, steady plant location in the row, and finally – the increase of crop productivity.

The level of sugar beet yield and technological properties depends on numerous factors, which in turn enable complete disclosure of the potential of their genetic characteristics. When proper sugar beet quality is developed in the process of their vegetation, it is important to use various agro technological measures which lead to better yield and quality of sugar beets, as the processing of low quality raw material gives no economic effect.

It is not possible to enhance the processes of plant growth and development and a simultaneous formation of sugar beet productivity without the external factor effect. Among the most efficient factors which enhance the potential of sugar beet productivity are complex use of highly productive hybrids, the creation of optimal plant density, high agrochemical background and foliar application with micro fertilizers.

According to the data of A.S. Zarishniak and I.M. Zherdetskyi (2008), it is advisable to do foliar application of sugar beets three times during vegetation. The first foliar application should be done when there are four-eight leaves on the plants, the second one – before leaf closing in the inter-rows (15-18 leaves), the third top dressing – during the period of intensive root growth and sugar accumulation (July-August, 32-42 leaves), as sugar content in the roots is the major indicator of their quality (Sabluk et al., 2011).

In the trial foliar application was done twice – at a stage of leaf closing in the row and at a stage of leaf closing in the inter-row (136 days after sowing).

It was important to determine the effect of foliar application on pre-harvest plant density and sugar beet productivity in general.

In the experimental years pre-harvest plant density, on the average, was optimal for the area, namely, for hybrid Ukrayinskyi CHS 72 it ranged 101.9-104.8 th/ha, for hybrid Leopard – 101.9-104.4 th/ha. No significant variation in the correlation between plant density and varietal composition was recorded.

Plant density before harvesting together with soil-climate conditions and agro technological measures had an impact on sugar beet yield.

A substantial increase of root yield of both diploid hybrids of sugar beets was recorded when foliar application with microelements was done twice – at a stage of leaf closing in the rows and at a stage of leaf closing in the inter-rows (136 days after sowing).

With plant density 101-104 th/ha and microelement application rate calculated for root yield 70 t/ha in the area of unstable moistening, the yield of hybrid Ukrayinskyi CHS 72 was 57.1 тт/ha and that of hybrid Leopard – 58.9 t/ha (*Table 9*).

Table 9. **Sugar beet hybrid productivity depending on agrotechnological measures of growing, 2011-2014**

Variant		Yield of roots, t/ha	Sugar content, %	Yield of sugar, t/ha
hybrid	term of microelements introduction			
Ukrainian ChS 72	Without application	52.1	15.2	8.0
	closing leaves in a row phase + closing leaves between rows phase (136 days from sowing)	57.1	15.9	9.1
Leopard	Without application	53.2	15.3	8.1
	closing leaves in a row phase + closing leaves between rows phase (136 days from sowing)	58.9	15.9	9.4
$LSD_{05\ \text{year conditions}}$		1.20	0.18	0.25
$LSD_{05\ \text{hybrid (factor A)}}$		1.22	0.15	0.21
$LSD_{05\ \text{feeding (factor B)}}$		0.98	0.15	0.21
$LSD_{05\ \text{interaction of factors (1*2*3)}}$		2.40	0.37	0.51

Source: own research.

The yield increase of both sugar beet hybrids ranged from 5.0 (hybrid Ukrayinskyi CHS 72) to 5.7 t/ha (hybrid Leopard), compared with the control ($HIP_{05\ \text{hybrid}}$=1.22 t/ha). No significant variation in sugar beet productivity depending on the studied hybrids was recorded.

Within a four-year period, on the average, sugar beet productivity was mostly influenced by year conditions, which effect share was 70%, and top dressing – 15%. Varietal characteristics were insignificant; their effect share was only 5%.

Top dressing of sugar beets resulted in the increase of beet sugar content, in particular: hybrid Ukrayinskyi CHS 72 by 0.7%, hybrid Leopard by 0.6% ($HIP_{05\ \text{top dressing}}$= 0.15 %).

In the experimental years, on the average, root sugar content of the control was 15.4-

15.5 %, and with two-time foliar application it was 15.8-15.9 %. No significant variation in root sugar content depending on varietal characteristics was recorded.

Due to the increase of root yield and sugar content, when foliar application with microelements was done twice, sugar yield increased considerably, compared with the control without foliar application. In the experimental years, on the average, with foliar application, sugar yield of hybrid Ukrayinskyi CHS 72 was 9.1 t/ha, that of hybrid Leopard – 9.4 t/ha; sugar yield increase was 1.1 and 1.3 t/ha, correspondingly. No significant variation in sugar yield and its increase depending on hybrids was recorded.

The results of field trials are confirmed by testing the implementation of complex measures taken in farm businesses – ALLC "Agrosvit", Myronivka district, Kyiv region and LLC "Zemlia Tomylivska", Kyiv region: highly productive diploid and triploid hybrids with 96-98% of deed germination, 107–109 th/ha plant density, on the background of main fertilizer, foliar application with microelements at a stage of leaf closing in the row + at a stage of leaf closing in the inter-rows, root harvesting at the end of October –the first decade of November; the aim was to determine sugar beet productivity. In agricultural limited liability company "Agrosvit" (ALLC) on the area of 200 ha sugar beet productivity of hybrid Ukrayinskyi CHS 72 was 52.3 t/ha, sugar content was 16.5 % , sugar yield was 8.6 t/ha. The yield increase was 0.3 t/ha, and sugar yield – 0.5 t/ha, compared with the complex trial which was carried out in ERC of BNAU. In limited liability company "Zenlia Tomylivska" (LLC) on the area of 200 ha the increase of sugar beet productivity with complex application of agro technological measures was 1.1 t/ha, that of sugar content was 0.7 % , and sugar yield was 0.5 t/ha.

There are several important conclusions, that have to be mentioned, such as:

1. According to a complex effect of hydro-meteorological conditions it was established that precipitation, which occurred in June, had the largest impact on sugar beet yield in the area of their cultivation. However, in the experimental years little connection (r = 0.29) was found between biological form yield (from 53.1 to 62.7 t/ha) and precipitation amount in June (from 61.7 to 137.4 mm). It was determined that there was no significant variation between biological sugar beet forms as to their yield, sugar content and sugar yield. The share of biological form effect on root yield was irrelevant, only 6%.
2. In the zone of unstable moistening plant density can be increased as much as to 101-110 th/ha. Its further increase ensured the decrease of sugar beet productivity rather than its increase. Plant density had a significant effect on root yield and sugar yield, but sugar content depended more on year conditions.
3. It was proved that terms of microelement application, types of micro fertilizers and their application rates had effect on sugar beet productivity. The use of new micro fertilizers Reacom-plus-beet and Reastim-humus-beet on the background of main fertilizer guaranteed a considerable increase of sugar beet productivity when compared not only with the control (without foliar application) but also with the use of micro fertilizer Reacom-R-beet (the standard). Foliar application with different micro fertilizers (3.0 to 7.0 l/ha) at a stage of leaf closing in the row and at a stage of leaf closing in the inter-rows (136 days after sowing) favored better assimilation of microelements from the soil, which in turn influenced final sugar beet productivity. Top dressing with helatic micro fertilizer Reacom-plus-beet done in the second application term (7 l/ha) was the most efficient measure, which resulted in root yield increase by 18.6 t/ha and sugar yield by 2.6 t/ha, if compared with top dressing with micro fertilizer Reacom-R-beet (the standard).

4. In the trials the productivity was associated with genotype expression. It was found out that regardless of their origin triploid hybrids responded to top dressing positively. The increase of sugar beet yield ranged from 3.9 to 6.4 t/ha (HIP_{05} = 3.9 t/ha), compared with the control. The highest yield – 62.8 t/ha – was received on hybrid Oriks with two-time foliar application, its increase was equal to 17.2 t/ha, compared with the control.
5. A complex experiment proved that in the area of unstable moistening of the Right-Bank Forest Steppe zone of Ukraine, to supply plants with moisture is a limiting factor. The calculations of moisture consumption showed that in the experimental years the amount of moisture was enough to reach the yield of 60 t/ha, that is, the yield indicator which was received in this trial.

3. Improving the marketing of products of the sugar industry

Current state of sugar beet production and sugar branch of Ukraine explains the necessity to create conditions to ensure efficient sugar beet production and their processing for sugar. However, the factors of the efficiency enhancement of the branch businesses are not coordinated well or they are not used to due extent, which makes economic situation at sugar market more complicated due to its over- or under-production and a low level of producers' efficiency does not provide extended reproduction.

Marketing is an important part of enterprise management system operation and provides future opportunities for its effective development in the changing conditions of the market environment. Decisive is the role of marketing in the sugar sector enterprises, particularly as a prerequisite for the implementation of productive activities, the management of goods movement in the process of pricing and product evaluation possible volume of demand and supply and the main by-products of sugar production.

The importance of the output of sugar and sugar beet production consists not only in the source of the production of the important foodstuff – sugar. A market of alternative fuel kinds based on the use of sugar and starch-bearing agricultural crops and processed products is created across the world. As the problem of supplying our country with power--carriers becomes urgent, it is expedient to speed up and diversify the manufacture of alternative fuel kinds, in particular, bio ethanol and biogas. The challenges of the development of the sugar beet production should be clearly determined at a national level – the use of sugar beets and the products of their processing for the manufacture of alternative fuel.

At present sugar beet production and sugar branch of Ukraine are in a difficult situation. Due to the lack of circulating assets and proper logistics sugar-planting companies are not interested in growing sugar beets, and sugar-mills do not have enough sugar raw materials. The output of sugar production in Ukraine depends on the gross harvest of sugar beets, their yielding capacity and the sown area under this crop.

One of the ways to increase the efficiency of sugar beet production in Ukraine is to follow production technologies of growing sugar beets, their main elements are plant nutrition and pest management (pests, diseases and weeds); the latter together with soil--climatic conditions favor the yield increase and its harvest volume per hectare.

The yield increase of sugar beets resulted from the development of arable farming and better observance of the technologies. In 2001 producers applied 90 kg of acting substance (as) of mineral fertilizers per hectare, then in 2015 – 274 kg, i.e., three times more (State Statistics Committee of Ukraine, 2016). Close direct correlation between the amount of mineral fertilizers applied and the root yield was determined. The correlation coefficient is 0.93. Recently special attention has been paid to the protection of sugar beets from pests and diseases which decrease their productivity considerably. In 2001, 8.9% of sugar beet area before harvesting was protected from diseases (mainly cercosporosis), in recent years all the field have been protected. Sugar beet fields were better protected from weeds as well. In 2001, 65.9% were treated with herbicides, and then in recent years every sugar beet field has been treated with herbicides three times.

As to soil potential, peculiarities of climatic conditions, a sugar belt was determined by the Institute of bio energetic crops and sugar beets of Ukraine's NAAS (Royik, 2001). The most favorable zone for sugar beet cultivation, where 55-60 t/ha can be harvested, is western regions of Ukraine – Volyn, Ivano-Frankivsk, Lviv, Rivne, Ternopil and Khmelnytsk. The less favorable zone, where 50-55 t/ha can be harvested, includes Vinnytsia, Zhytomyr, Kyiv, Poltava, Sumy, Kharkiv, Cherkasy and Chernihiv regions. The area where only 45-50 t/ha can be harvested is Kirovohrad ad Chernivtsi regions. The rest of the regions, where sugar beets are grown and which are not included in a sugar beet belt, are unfavorable for sugar beet production because of their soil-climatic conditions.

Thus, Ukraine's agrarian policy has to take into account and to respond to the consequences, associated with the country's membership in WTO, and to support both the concentration of sugar beet cultivation in the proper regions and sugar beet farms.

Recently, integrated companies in the sugar branch have been created; they participated in the season of sugar beet processing of 2015-yield, as a result 75.7% of sugar was produced to the total production. Production concentration of sugar raw material in powerful specialized companies makes it possible to grow sugar beets using intensive technologies which in turn results in the increase of yield and gross output.

In Ukraine at the beginning of the 90ties there were 192 sugar-mills with total capacity 509.7 th t of sugar beet processing per day, in 2001 – 147 sugar-mills with total capacity 339.0 th t, and in 2012 – 63 sugar-mills with total capacity 255.4 th t. It is worth mentioning the years when 192 sugar-mills of Ukraine were built: before 1860 – 58 sugar-mills, 1860-1900 – 66 mills; 1901-1940 – 24 mills; 1941-1996 – 44 sugar-mills (The legislative provision, 2005).

In recent years the number of working sugar-mills fro sugar beet processing has been reduced by four times. And the sugar output at Ukraine's sugar-mills increased from 11.4% in 2001 to 14.68% in 2015 (*Table 10*) (Yarchuk, 2015).

Within the year of 2015 sugar-mills of Ukraine received 9.91 mln t of sugar raw material or less by 34.6% compared with 2001, they processed 9.72 mln t of sugar beets and produced 1.43 mln t of sugar or 6.03 t/ha which does not satisfy the need of the internal market of Ukraine to its full scale. The difference between the duration of a technological process and that of sap extraction was 3.6 days per mill, i.e., that was idle time for each working mill. At some mills, stations of sap-extraction, defeco-saturation and product units work below their production capacity, which results in 1.73% of sugar in molasses (2001 – 2.24%).

However, automation level of some technological units has been improved which has positive impact on operation indicators of sugar mills. In Ukraine mill coefficient which characterizes the degree of sugar extraction from beets was 0.8172 (2001 – 0.723), and operation coefficient of the mill was 0.8506 (2001 – 0.7808), i.e., 85.06% of biological sugar from the received amount was extracted in the mill. Unfortunately, the difference between mill coefficient and operation coefficient – 0.0334 (2001 – 0.0578) – is high in the branch; and it confirms large losses of beets and sugar when rot beets are received, stored, transported to the sugar mill.

Table 10. Indicators of sugar beet processing and sugar production in Ukraine

Indicator	Year				2015 in % to	
	2001	2013	2014	2015	2001	2014
Procured beets at the mills, mln t	15.15	9.22	15.11	9.91	65.4	65.6
Processed beets, mln t	14.57	9.06	14.81	9.72	66.7	65.6
Beet loss in storage, %	3.8	1.70	2.02	1.85	-	-
Sugar produced from beets, mln t	1.33	1.26	2.05	1.43	107.5	69.8
Produced sugar, t/ha	1.56	4.66	6.22	6.03	386.5	96.9
Production coefficient	0.7230	0.8071	0.8071	0.8172	113.0	101.3
Duration of sap extraction, days	42.6	61.04	81.46	68.2	160.1	83.7
Number of working mills	147	38	48	36	24.5	75.0
Average daily amount of processed beets per 1 sugar mill, th t/day	2.71	3.62	3.75	3.75	138.4	100.0
Sugar output, %	11.40	13.35	14.04	14.68	-	-
Sugar content in molasses, %	2.24	1.76	1.73	1.73	-	-
Mill coefficient	0.7808	0.8364	0.8439	0.8506	108.9	100.8
Operation term of sugar mills, days	47.6	64.80	84.90	71.8	150.8	84.6

Source: own research.

It has to be mentioned that 25 sugar mills which operated in 2015-season consumed natural gas for their production needs. Total consumption at these mills was 214.4 mln m^3 of natural gas, and natural gas consumption per 1 t of processed sugar beets was 34.07 m^3 comparing to 34.4 in 2014. The share of fuel and power in processing production cost of 1 t of sugar beets is about 38%, and its share in sugar production cost is 27%. It encouraged sugar mills to look for alternative kinds of fuel to substitute natural gas.

According to the statistics of the National association of sugar producers of Ukraine "Ukrtsukor", at the beginning of operation season-2015 some renovation work concerning the preparation of the systems for using furnace fuel oil was carried out at several sugar mills; a number of sugar mills started their operation with total or partial substitution of natural gas. In 2015 sugar mills consumed 15.6 th t of pellet, 6.1 mln m^3 of biogas, 13.2 th t of peat, 68.5 th t of bituminous coal for their operation needs. It made it possible to substitute 100 mln m^3 of natural gas with alternative fuels during the operation season. As the average price of 1000 cubic meters of natural gas is UAH 6600, cost cutting is UAH 660 mln (The National Commission, 2015).

The power balance of a sugar mill shows that 85-90% of the total fuel consumption goes for the manufacture of heat energy for technological needs, and 10-15% – for the manufacture of electric power, lime and carbon dioxide. So, a significant way to reduce specific consumption of fuel-power resources is to reduce heat power consumption for sugar beet processing.

The necessity to diversify the supply of sugar mills is defined not only by high dependence of the country on power resource import, but also by the need to have reserve capacities to process the surplus of the produced output taking into account a cyclic and risky nature of sugar beet production.

In Ukraine the developed sugar beet production is a universal basis for the production of bioethanol. The greatest output of bioethanol per unit area at the appropriate level of yield can be obtained from the sugar beets. However, in the processing of sugar beet into sugar we get the molasses, and depending on its quality the output of bioethanol from 1t can be 0.222-0.237 t (*Table 11*).

Table 11. **The calculation of the output of bioethanol from various types of raw materials by the different yields**

Raw	The output of bioethanol from 1t of production, t	The output of bioethanol in calculating per 1 ha depending on the yields of culture, t	
		yield	output of bioethanol
Sugar beets (crude juice)	0.074-0.079	40.0	2.96–3.16
		50.0	3.70–3.95
		60.0	4.44–4.74
Molasses (processing of sugar beet into sugar)	0.222-0.237	1.56	0.35–0.37
		1.95	0.43–0.46
		2.34	0.52–0.55
Wheat	0.237-0.311	3.0	0.71–0.93
		4.0	0.95–1.24
		5.0	1.19–1.56
Corn	0.321-0.346	4.0	1.28–1.38
		5.0	1.61–1.73
		6.0	1.93–2.08

Source: own research.

Hence, the development of commodity policy and the extension of product range of sugar mills is one of the most promising and efficient ways which will facilitate the efficiency enhancement of sugar branch companies. The intensification of this trend is possible in the conditions of total and rational use of raw materials which come for sugar manufacture, and also in the conditions of complex processing of by-products of sugar production.

The importance of sugar beets is not limited to the manufacture of sugar. When sugar beet is processed, beet pulp and molasses are produced. Beet pulp is used to feed animals and to manufacture pectin glue, used in textile production. Molasses is widely used in animal feed manufacture. It is raw material for spirit/alcohol production as well as glycerin, good yeast for bakery industry (Sabluk, Kodenska, & Vlasov, 2007).

Taking into consideration the world experience as to the use of sugar raw material to produce alternative fuel, it would be expedient to use it at sugar mills of Ukraine. It is possible to set up the production of bio ethanol from sugar beet processed products, and that of biogas – from beet pulp. The use of sugar beets and their processed products to manufacture other items in addition to sugar makes them competitive compared with other agricultural crops.

Table 12. Diversification trends of sugar mill output

Processed output of sugar beets	Consumption
Sugar	- technical purposes
	- consumption by population
	- consumption in food industry
Beet pulp	- to feed animals with fresh, sour, granulated beet pulp
	- silage
	- manufacture of pectin glue
	- manufacture of biogas (electric power, organic fertilizers)
Molasses	- processing for spirit, glycerin, dry yeast
	- manufacture of animal feed, cleaning of dry beet pulp
	- separation to get sugar
	- animal feed enrichment
	- manufacture of bio ethanol
Defecate	- manufacture of fertilizers, building material
Bioethanol	- admixture to gasoline

Source: own research.

The production of bio ethanol is possible by using several schemes. The first option is to set up the workshop for bio ethanol manufacture at the sugar mill. The mill produces sugar with help of traditional technologies, and bio ethanol – from molasses. The second option is to produce bio ethanol from syrup. This practice can be used at alcohol-producing plants situated near sugar-mills. Another way to manufacture bio ethanol envisages the manufacture of sugar and bio ethanol from molasses and syrup. In this case two processes are combined at the mill, and correspondingly, its productivity increases and production cost of the output decreases. The optimal practice is the construction of combined workshops at sugar-mills and alcohol-producing plants; during sugar beet harvesting season they will manufacture bio ethanol from processed products, and in-between season (shoulder period) – from grain wastes of headed grain crops or corn.

At present processing, storage and utilization of beet pulp present a problem for the majority of sugar mills in Ukraine. The economic conditions of running business in the regions of sugar beet processing and the availability of sugar beet processing companies affect the solution of this problem. The main promising trends in the consumption and utilization of beet pulp are: valuable fodder for cattle, pectin concentrate and pectin glue, biogas with further manufacture of electric power. One of the potential ways to create demand for beet pulp is its use as valuable fodder for cattle.

Alongside with this, a considerable amount of biogas will be consumed by sugar mills for their own needs, however, if proper equipment is used, then the remaining power can be sold to other consumers according to “green tariff”. It is possible to use units for simultaneous manufacture of electric power and heat, and also special equipment for biogas cleaning and using it as traditional fuel for vehicles and other agricultural machinery.

Among other kinds of alternative fuel sources for the companies of the sugar branch and sugar mills in particular, the use of biogas is the most economically advisable and acceptable one. However, producers face some difficulties in introducing biogas units, namely, large initial investment expenses (it costs UAH 200 mln to build and put into operation a biogas unit with power capacity equal to 2.25 MVt); low credit activity in the sugar industry; the necessity to get a license to produce biogas; the lack of standard documentation for design, construction and operation of biogas units, etc. The lack of building code for biogas reactors is a legal problem.

Conclusions

Marketing of sugar industry companies – an activity that is associated with a complex sugar market research in order to expand product range, pricing, sales and meet the needs of enterprises of the sugar industry and consumers.

The increase of operation efficiency of sugar beets and sugar is possible through the output diversification of sugar mills of Ukraine. Besides, sugar beet production should be concentrated in the most favorable regions for this crop, whose soil-climatic conditions ensure high indicators of the yield and quality of the root beets. The increase of sugar beet productivity will satisfy the needs of sugar in the internal/domestic market, and it will result in the output diversification of sugar mills as well. In addition to sugar, it is expedient to produce heat and electric power, bio ethanol and biogas at the sugar mills.

Supply diversification of the sugar mills will allow:

- to set up the manufacture of ecologically clean alternative fuel – bio ethanol, biogas, and also that of electric power according to "green tariff";
- to create jobs;
- to increase business profits;
- to get additional fodder for livestock production;
- to decrease the dependence on fuel import and to guarantee food security of Ukraine.

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