REPORT

about the research carried out on a contractual task assigned by DZZD PANAMIN & CO /Austria/ represented by Angel Kinanov

ON SUBJECT:

Study of the effect Panamin Agro on the productivity and the quality of winter cereal crops - wheat and barley in the conditions of Southeastern Bulgaria

Director: *(Sgd. illegible)*
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Round seal of Agricultural Institute - Karnobat

Place of the scientific research: Agricultural Institute - Karnobat, Southeast Bulgaria, Trial plot in the village of Glumche

Scientific team:

Professor DSc Darina Valcheva – Head of the scientific team

Assistant DSc Marina Stoyanova – executor

Professor DSc Dragomir Valchev – executor

Purpose of the test: To find the effect of ***PANAMIN AGRO*** on the productivity and the quality of cereal crops – wheat and barley

During the growing year 2016/2017, a field test was carried out with wheat and barley, with size of the harvest plot 10 m2, of 3 variants in 4 replicates and field trial with the size of the harvest plot 10 dca. Barley, varieties Zemela and Kuber and wheat, variety Miryana were used. The following variants were used:

Variant I – Control group – the plants are grown by the standard technology

Variant II – Without nitrogen fertilization, treatment by spraying in autumn with 150 g/dca Panamin /3-6 leaf of the plant growth/ and two treatments with the same dose in April at interval of 8-14 days

Variant III - Nitrogen fertilization is reduced to 50%, two treatments in April with 150 g/dca Panamin at interval of 8-14 days

Tables 1 and 2 show data for the average monthly temperatures and the precipitations per months for the growth period. The analysis of the results shows that the growing year 2016/2017 is characterized by much less precipitation compared to the multiannual values. The total precipitation during the growth period is 302.9 mm, while the typical precipitation in the region is 474.5 mm, which means 171.6 mm less precipitation during the growth period. Monthly droughts start in autumn, with deviation from -16.8 mm in November to -45.5 mm in December. The germination of the trials was only possible after the 36.9 mm rainfall in November. The average monthly temperatures for the period show that the plant growth starts at lower temperatures than the usual ones for the region. The deviation reaches -2.0 °C in December. The winter months of 2017 had average monthly temperatures for January by -3.1 ° C lower than the average multiannual values. Despite the snow blanket around the New Year, which remained throughout the whole January, the precipitation during the first three months of the year remained lower than the typical for the region. After the sustained spring warmth in March and the restoration of the growth, the dead plants during the winter recorded. The total dead barley plants are about 13%, both in the control groups and in the fertilized variants. The dead wheat plants are less than 7%, and again there is no difference between the control groups and in the trial variants. The spring growth of the plants continued in drought conditions, the most noticeable being in May, when the deviation versus the multiannual values reached -21.9. The warm and dry weather during the period of ripening and maturing of the grain affected the plants negatively. The crop remained stubby and the ears remained shorter. Generally, the year 2016/2017 was not favorable for the growth of wheat and barley. The lack of precipitation somewhat limited the attack of diseases in both crops. The plant protection measures protected the plants until the natural end of their growth.

Table 1. Average monthly temperatures in °C during the growth for the reporting period – year 2016/2017

Indicators / Months	X	XI	XII	I	II	III	IV	V	VI	VII
Average monthly temperatures for year 2016/2017	12.0	7.4	0.6	-2.5	3.4	8.3	10.1	16.1	21.7	23.4
Average multiannual monthly temperatures	12.5	7.1	2.6	0.6	2.2	5.3	10.5	15.6	19.6	22.0
Deviation	-0.5	0.3	-2.0	-3.1	1.2	3.0	-0.4	0.5	2.1	1.4

Table 2. Precipitation in mm per months during the growth for the reporting period – year 2016/2017

Indicators / Months	X	XI	XII	1	II	III	IV	V	VI	VII	Σ
Precipitation per month for the year 2016/2017	6.7	36.9	5.7	28.9	32.9	24.1	35.4	36.6	55.0	40.7	302.9
Multiannual precipitation per month	44.3	53.7	51.2	36.5	35.8	34.1	45.3	58.5	65.2	49.9	474.5
Deviation	-37.6	-16.8	-45.5	-7.6	-2.9	-10.0	-9.9	-21.9	-10.2	-9.2	-171.6

Table 3 presents the chlorophyll content of the leaves during the period of ripening and maturing of the grain in the various test variants. The results show a higher level of chlorophyll in all variants treated with Panamin. The highest values for wheat and barley were found in variant III.

Table 3. Chlorophyll content of the leaves during the period of ripening and maturing of the grain – field micro-trial /SPAD/

Variety	Variant 1 - control group	Variant II	Variant III
Miryana – wheat	6.4	10.5	24.1
Zemela – barley	8.1	14.8	25.3

The effect of Panamin on the crop microclimate is determined: the surface temperature of the soil outside the crop by means of an infrared thermometer - Oakton; the surface temperature and inside the crop by means of thermometers Oakton and Extech; the air temperature by means of thermometer Extech; the air humidity outside and inside the crop by means of moisture meter Extech.

It was found that the tested product lowers the surface temperature of the crop and slightly increased the temperature and the relative humidity inside the crop (Table 4). This is probably due to a better developed root system that provides a better water regime for the plants, which by changing the intensity of transpiration regulate the microclimate in the crop.

The albedo of the crop is determined by means of light meter Extech Instruments 407026. The various studies have found that in industrial conditions the crops use average 0.5-1.0% of the light energy that falls on them. This means that the modern varieties have many times greater opportunities for increasing of the yield. The test determined the albedo of the crops of the tested barley and wheat varieties. This indicator reveals the capacity of the crop to utilize the fallen solar radiation. In similar tests in drought conditions the daily values of this indicator for barley and wheat sowing range between 1.0 and 8% (Febrero et al., 1998). In this test these values are highest in the control variant of the tested varieties and decrease in all three trial variants (Table 5). The increased utilization capacity of the leaves is probably due to the increased chlorophyll content in the leaves of the variants treated with Panamin.

Table 4. Microclimate of the crops of barley and wheat varieties in phase ears.

Variety	Variant I - control group			Variant II			Variant III		
	Surface temperature of the crop, °C	Temperature inside the crop, °C	Relative humidity inside the crop, %,	Surface temperature of the crop, °C	Temperature inside the crop, °C	Relative humidity inside the crop, %,	Surface temperature of the crop, °C	Temperature inside the crop, °C	Relative humidity inside the crop, %,
Miryana	32.3	34.8	35.4	32.0	34.5	34.7	32.1	33.9	34.9
Zemela	32.0	33.7	33.1	31.8	33.7	33.9	31.5	33.5	33.4

Air temperature 34.3°C

Relative air humidity 26.2 %,

Soil surface temperature 63.3°C

Average velocity of the wind 20.4 km/h

Table 5. Albedo of the crop in phase ears (%).

Variety	Variant 1 - control group	Variant II	Variant III
Miryana	5.1	5.0	4.8
Zemela	5.4	5.1	5.0

Table 6 shows the yield of barley and wheat. The treatment with Panamin leads to increased yield in the two wheat and barley variants. The yield is highest in variant III – 825 kg/dca /110.14 %/ for wheat and 759 kg/dca /117.67 %/ for wheat.

Table 6. Yield of barley and wheat varieties

Variety	Variant I - control group kg/dca	%	Variant II kg/dca	%	Variant II kg/dca	%
Miryana	749	100.00	787	105.67	825	110.14
Zemela	645	100.00	695	107.75	759	117.67

Tables 7 and 8 show the productivity elements for the different varieties of wheat and barley. For Miryana, positively higher plants were formed in variant II and in barley positively higher plants were formed in the two variants treated with Panamin. In wheat and barley, compared to the control group there is a significant increase of the productive shoots per m2 in both variants treated with Panamin.

There was a slight increase of the number of productive shoots in Miryana and Zemela. The length of the ear is positively higher in variants II and III. The same was determined for the barley. The number of grains was increased in both wheat and barley trial variants. The weight of the grain of the wheat is highest in II variant and reaches 2.7 g. In barley, the heaviest ears were also formed in variant II. This trend was also observed for the weight of the wheat and barley plants. The 1000 grain mass is high for the wheat in both variants treated with Panamin. The highest values of this indicator for barley were found in variant II.

Table 7. Productivity elements in wheat, variety Miryana

Indicators	**Variant I - control group**	**Variant II**	**Variant III**
Height of the plant, cm	73.8	74.9	82.6
Number of productive shoots per m2	565	601	628
Number of productive shoots per plant, number	3.0	3.0	3.1
Length of the ear, cm	8.7	9.1	9.6
Number of grains in the ear	52.4	57.7	57.7
Weight of the grain in the ear, g	2.4	2.6	2.7
Weight of the whole plant, g	5.3	6.1	6.5
Mass of 1000 grains, g	41.5	43.4	45.6

Table 8. Productivity elements in barley, variety Zemela

Indicators	**Variant I - control group**	**Variant II**	**Variant III**
Height of the plant, cm	70.2	71.3	72.4
Number of productive shoots per m2	760	770	785
Number of productive shoots per plant, number	3.4	3.5	3.6
Length of the ear, cm	7.2	7.6	7.7
Number of grains in the ear			
Weight of the grain in the ear, g			
Weight of the whole plant, g	5.4	5.6	5.6
Mass of 1000 grains, g	40.1	41.0	41.2

Tables 9 and 10 show the results for some qualitative indicators for wheat and barley. For wheat, the most favorable qualitative indicators are in variants II and III where large grains of high hectolitre mass, higher protein content and higher gluten values were formed. The treatment with Panamin has increased the gluten content by 4.0 % in variant III.

For barley, under the conditions of the climatically unfavorable year 2016/2017, grains were formed with very good qualitative indicators – large grain, high hectolitre mass. Higher protein content was determined in the grains after treatment with Panamin.

Table 9. Effect of the treatment with Panamin on the qualitative indicators of the grain in wheat, variety Miryana

Trial	Protein, %	Gluten, %	Softening, mm	Mass of 1000 grains, g	Hectolitre mass, kg
Variant I - control group Control group	11.9	19.6	5.8	41.5	80.4
Variant II	11.9	21.9	5.5	43.4	80.5
Variant III	12.7	23.6	5.2	45.6	80.5

Table 10. Effect of the treatment with Panamin on the qualitative indicators of the grain in barley, variety Zemela

Trial	Protein, %	Mass of 1000 grains, g	Hectolitre mass, kg
Variant I - control group Control group	10.5	40.1	73.6
Variant II	11.4	41.0	73.6
Variant III	11.4	41.2	73.8

In industrial conditions, a trial with the same variants was carried out /area of 10 dca for each variant/ with variety Miryana /wheat/ and variety Kuber /barley/. Table 11 shows that the

crops treated with Panamin have increased yield. In wheat and barley the increase reached almost 13.0%.

Table 11. Yield of barley and wheat varieties

Variety	Variant I - control group kg/dca	%	Variant II kg/dca	%	Variant II kg/dca	%
Kuber	372	100.00	404	108.60	417	112.09
Miryana	510	100.00	546	107.05	576	112.94

An economic assessment was made of the advantages of Panamin compared to the incorporation of ammonium nitrate in the production of wheat and barley. By the time of testing the Panamin, the price of the preparation is 17.87 BGN per kilogram and the price of the ammonium nitrate is 580 BGN per 1 ton. In the second variant, for the whole year 450 g Panamin were used, amounting to 8.04 BGN instead of 30 kg ammonium nitrate for 17.40 BGN, resulting in a saving of BGN 9.36 per 1 decare. In the third variant, where 50% of the ammonium nitrate is used, the price decreased by BGN 3.34 per 1 decare. Considering the increase in the yield by 8 to 12% in both crops, it can be said that it is economically justified to use Panamin in wheat and barley cultivation.

Conclusion: Since the results are for one year, no definitive conclusions can be drawn, but trends are still noticed. The results show that:

1. The use of Panamin in wheat and barley cultivation leads to increased chlorophyll content of the leaves of the plants.

2. In the variants treated with Panamin, increased utilization capacity of the leaves is observed.

3. In the trial variants, it was determined that the treatment with Panamin leads to decreased temperature of the surface of the crop, slightly increased temperature and relative humidity inside the crop, resulting in a better water regime of the plants, which by changing the intensity of transpiration regulate the microclimate inside the crop.

4. The treatment with Panamin increases the yield and improves the grain quality of the tested wheat and barley varieties.

It was found that the use this product is economically justified.