ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Formation Of The Yield And Grain Quality Of Winter Wheat Depending On Application Of Terraflex, A Water Soluble Complex Fertilzer.

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ABSTRACT

We have established a positive influence of Terraflex, a water soluble fertilizer on physiologic, biochemical and production processes in the plants of winter wheat. The studies have shown that when the plants were treated with Terraflex together with the use of mineral fertilizers the increase of intensity parameters of photosynthesis and mineral nutrition improvement takes place.There is also an increase of yield and improvement of produce quality ofthe experimental crop.
Keywords: wheat, Terraflex, a mineral fertilizer, mineral nutrition, productivity of photosynthesis, yield, grain quality.

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INTRODUCTION

In contemporary technologies a great practical significance of growth-regulating and growth-stimulating preparations is determined by many circumstances. Havingan effectonthegrowthanddevelopmentprocessesofplants they are capable of speeding up the growth significantly and raising the yield of a large number of crops. Atthesametimetheyareconsideredasanorganicandeconomicallyprofitablemethodofraisingthecropyieldthat makes it possible to realize potential possibilities of plant organisms[1,9].Preparations of this range intensify metabolic processes, raise the hardiness of plants to stress conditions, improve the quality of agricultural output, speed up ripening. Theyhaveaneffectonwinterhardinessofplants, reduce the content of nitrates and radionuclides in the output produced, have an impact on its storing. Awidespreadapplicationofthesepreparationswhichpossessamany-sidedaction range, contribute to a significant decrease of the application extent ofplant protection products from pests and diseases [3,4,5,8].

Their application is also an important efficiency factor of the winter wheat cultivation technology. Despitetheuseofsimilarsubstancesthat has becomea common practice recently, the action of many of them on crops has not been studied completely and requires further studies. Thatiswhythestudyoftheirinfluencein the technology of cultivating winter wheat in view of certain soil and climatic conditions of the Middle Volga Region is considered to beimportant.

Objects and methods of investigations

TerraflexN17 P17 K17 was the object of investigations. Terraflex –is a complex water soluble fertilizer containing nitrogen, phosphorus, potassium, magnesium and microelement chelates which is used in the period of intensive vegetative growth for rapid development of the elevated part of plants. It contains nitrogen in an amidic form which is taken up much faster and more effectively by plants. Diammophoska was used as a mineral fertilizer that contained N15P15K15 with a mass share of sulfur 10 %, and diammophoska N15P15K15 that did not contain sulfur. The experimental crop –winter wheat of the variety Biryuza (Turquoise). Thetechnologyofcultivatingwinterwheatwas based on the agrotechnical practices commonly accepted in the Ulyanovsk region.

The studies were conducted in 2011 – 2015 on the experimental field of the Ulyanovsk State Agricultural Academy. Thetotalareaoftheplot40 m^2 (4x10), the registration plot area – 20 m^2 (2x10), the experiment replication is quadruple,the plot lay-out is randomized. Thesoiloftheexperimentalfield –average clay-loam, leachedblacksoilof average thickness with the following characteristics: the humus content - 4,3 %, mobile compounds of phosphorus and potassium (according to Chirikov) 193 and 152 mg/kgof the soil respectively, the content of mobile sulfur - 4,7 mg/kgof the soil, pHof the salt extract - 5,3.

The following observations, records and analyses were carried out in the experiment: the leaf surface area was determined according to the leaf parameters on ten plants from a plot in conformity with the plant development phases by a formula: S = a* b *К; where S – is the area of leaves of one plant, cm^2; a – is the length of a leaf, cm; b – the width of a leaf, cm; K – is a correction factor (0,78);the accumulation of dry biomass in plants was registered according to N.N. Tretyakov, (2003); net productivity of photosynthesis was calculated by a Kidd, West and Briggs's formula:

$$NPP = \frac{B_2 - B_1}{(L_1 + L_2) \bullet 0{,}5 \bullet n},$$

Where NPP – net productivity of photosynthesis(gr/m^2inaday; B_1иB_2 – dry biomass of the yield sample at the beginning and the end of the registration period, gr; $(L_1 + L_2) \bullet 0{,}5$ – average working area of leaves for this time span, m^2; n – number of days. Soilsamplesfortheinitialagrochemical characteristics were collected in the layers 0 – 30 or 30 – 50 cmin nine points on two diagonal lines, we determined: pH (КС1) by a potentiometric method (State standard 26483-85), hydrolytic acidity – according to Kappen (State standard 26212-84), total absorbed bases – according to Kappen-Gilkovits (26212-84), humus – according to Tyurin and modified by the Central Research Institute for Agrochemical Service of Agriculture (State standard 26213-91).In plant samples the content of nitrogen (State standard 134916.4-93), phosphorus (State standard 26657-97), potassium (State standard 30504-97), sulfurwas determined(the method of CRIASA).Theprotein content in the grain was determined according to State standard 10846–91;the mass share of gluten according to State standard 54478 – 2011, the quality of gluten by means of the deviceIDK–3; the registration of the real yield was conducted in view of the total plot area recalculated to100 %-grain purityand 14 %-humidity (State standard 27548-97).

RESULTS AND DISCUSSION

The yielding capacity of winter wheat depends on the presence of a number of factors. It is too demanding in relation to so il fertility and very responsive to fertilizers. Identification of then ecessity of crops in nutrients at certain stages of growth and development has a great practical significance while establishing the optimum term and method of applying fertilizers [6,7].

Besides, the intensity of biochemical and growth processes flowing in plants and consequently, the need in nutrients are different at individual stages of ontogenesis. Alongwithselectivitytheplantsare characterized by the unevenness of the nutrients consumption during vegetation. Despitethesubstantialdifferencesofdynamicpatternsin consumption of nutrient substances in various plant species they all have common trends of nutrition.

The content of nutritive elements in the organs of plants and their proportion in certain periods of growth and development is an important diagnostic indicator of the nutrient availability level which is widely used in practice.

In the course of studies it has been found that maximum accumulation of sulfur in winter wheat leaves was detected in the phase of seedling emergence. In subsequent phases the decline of sulfur containing compounds in winter wheat leaves is observed reaching the minimum value in the phase of milky ripeness. This tendency is explained by their intensive outflow into reproductive organs which is very important in the formation of high-quality winter wheat .Thesulfurcontentdynamicsinthestalksofwinterwheatwas similar to that of the leaves, that is a gradual decline of this value was observed with succession of subsequent phenophases (table1).

On average in they ears of studies the sulfur content increase in the organs of winter wheat due to the use of Terraflex preparation was from 0,004 to 0,025 % –on the plot without fertilizers, from 0,004 to 0,017 % – on the plot fertilized with NPK, from 0,003 to 0,021 % – on the plot fertilized with NPKS, in contrast to the control group depending on the phase of growth and development.The lowest content of this element both in stalks and in leaves is observed in the phase of milky ripeness of the experimental crop. Under the action of Terraflex preparation the sulfur content rises in reproductive organs by 0,017 - 0,025 %.

The nitrogen content in the organs of winter wheat changed depending on soil and climatic conditions and the way of applying the investigated preparation. The biggest nitrogen content in winter wheat leaves was observed in the phase of seedling emergence and tillering and was from 3,01to 3,97 %,depending on the nutrition mode.High uptake of the studied element in this period is determined by the fact that plants need a large amount of protein to build up tissues. In the subsequent phases of growth the decline of nitrogenous compounds in leaves of the crop is observed reaching the lowest level in the phase of milky ripeness of grain (table 1). Thegreatestaccumulationofnitrogeninleavesof winter wheat in all the phases of growth and development was in the variant Terraflex with fertilized ground.

On average in the years of studies the nitrogen content increase in organs of the experimental crop due to a used factor was from 0,12to 0,24 % – on the ground without fertilizers from 0,06 to 0,29 % – on plots withNPK.Thedynamicpatternofthenitrogencontentin winter wheat stems is similar to a dynamic pattern of leaves. Agradualdec line of the considered indicator was also observed in view of subsequent phenophases. Maximum amount of nitrogen was detected in the variant Terraflex on plots fertilized withNPKSand was 1,45 %. Minimum nitrogen content both in leaves and in stems was determined in the phase of milky ripeness of winter wheat.

In the course of our studies it has been found that Terraflex had a positive influence on dynamics of the phosphorus contentin winter wheat plants (table1). The data analysis of this element's accumulation on the phases of growth and in some organs showed the similarity to the nitrogen content dynamics in plants. The maximum phosphorus content in leaves was in the phase of seedling emergence and tillering and amounted to 0,79 – 1,27 % and 0,65 – 1,1 %, respectively. In the process of growth and development of winter wheat plants the amount of phosphorus in a leaf and stalk biomass diminished and simultaneously its content increased in reproductive organs. While using mineral fertilizers with NPKSthe content of this element went up in relation to the plot fertilized withNPKon averageby 0,05 – 0,13 % and by 0,25 – 0,32 % in relation to plots with natural soil fertility during the whole vegetation period of winter wheat.

The greatest effect in the phosphorus content in the organs of winter wheat was obtained in the variant Terraflex on plots fertilized withNPKS. On average for the years of studies an increase was from 0,20to 0,36 %, depending on the growth and development phase.

The potassium content in winter wheat leaves to a certain extent depends on the moisture content during the period of the studies. The years 2013 – 2014 according to climatic conditions were more humid in comparison with others and the content of the studied indicator in the plants of winter wheat was found to be higher than in 2011 – 2012, 2014 – 2015.

In accordance with the results of the experiment it has been found: the magnitude of this element in leaves and stalks of winter wheat was the greatest in the phases of seedling emergence, tillering and shooting and this confirms the biggest need in potassium by plants in the period of their intensive growth.

Table 1: Dynamic pattern of microelements content in winter wheat organs, in % in relation to absolute dry matter (mean values for 2011 – 2015)

Variant	Seedling emergence	Tillering	Shooting		Ear formation			Milky ripeness			Grain
		leaves	leaves	stalk	leaves	stalk	ear	leaves	stalk	ear	
Non-fertilized plots											
Sulfur											
Control	0,203	0,182	0,175	0,125	0,171	0,110	0,084	0,098	0,060	0,127	0,145
Terraflex	0,207	0,188	0,183	0,129	0,178	0,113	0,088	0,108	0,064	0,138	0,170
nitrogen											
Control	3,59	3,01	2,78	1,16	2,10	0,70	1,31	1,92	0,94	2,02	2,38
Terraflex	3,80	3,28	3,11	1,30	2,32	0,82	1,41	1,79	1,03	2,21	2,72
phosphorus											
Control	0,79	0,65	0,42	0,29	0,32	0,23	0,38	0,25	0,21	0,38	0,39
Terraflex	1,07	0,91	0,63	0,51	0,53	0,41	0,58	0,42	0,34	0,51	0,55
potassium											
Control	2,72	2,66	2,35	1,59	2,13	1,45	0,99	1,40	0,89	0,43	0,45
Terraflex	2,97	2,82	2,48	1,72	2,27	1,59	1,11	1,51	0,98	0,52	0,57
Plots fertilized with NPK											
sulfur											
Control	0,205	0,184	0,178	0,128	0,175	0,111	0,086	0,101	0,062	0,136	0,161
Terraflex	0,209	0,191	0,185	0,132	0,180	0,115	0,093	0,112	0,068	0,148	0,178
nitrogen											
Control	3,65	3,11	2,88	1,25	2,19	0,76	1,36	1,90	0,99	2,15	2,54
Terraflex	3,86	3,33	3,15	1,38	2,38	0,89	1,48	1,87	1,11	2,37	2,85

Prolongation of table 1											
phosphorus											
Control	0,86	0,71	0,46	0,35	0,38	0,28	0,43	0,30	0,26	0,43	0,45
Terraflex	1,14	0,95	0,72	0,60	0,58	0,50	0,64	0,49	0,45	0,62	0,66

ISSN: 0975-8585

potassium											
Control	2,86	2,73	2,42	1,64	2,19	1,53	1,06	1,45	0,92	0,48	0,50
Terraflex	3,05	2,89	2,56	1,78	2,33	1,66	1,19	1,61	1,02	0,60	0,63
Plots fertilized with NPKS											
sulfur											
Control	0,211	0,186	0,180	0,130	0,177	0,113	0,089	0,105	0,065	0,140	0,166
Terraflex	0,219	0,193	0,190	0,133	0,183	0,117	0,098	0,116	0,073	0,151	0,187
nitrogen											
Control	3,73	3,20	2,97	1,31	2,25	0,82	1,42	1,85	1,06	2,22	2,62
Terraflex	3,97	3,43	3,24	1,45	2,47	0,99	1,57	1,75	1,17	2,43	3,01
phosphorus											
Control	0,91	0,78	0,52	0,41	0,43	0,34	0,48	0,35	0,31	0,48	0,51
Terraflex	1,27	1,10	0,82	0,68	0,66	0,57	0,71	0,56	0,52	0,70	0,71
potassium											
Control	2,92	2,79	2,46	1,68	2,23	1,57	1,11	1,50	0,97	0,55	0,59
Terraflex	3,12	2,97	2,61	1,81	2,38	1,70	1,28	1,63	1,06	0,66	0,71

The application of Terraflex increased the potassium content in winter wheat organs by 0,12 – 0,25 %, in comparison with the control group (table1). The greatest augmentation was on the plot fertilizedwith NPKSmineral fertilizers. Potassiumischaracterizedbyits multiple use (reutilization)and it easilymoves from old tissues where it was used into young ones. This seems to explain an insignificant change in the potassium content dynamics in organs of winter wheat plants under the influence of the studied factor.

Thus on the basis of the study results we can draw a conclusion that the application of Terraflex, both on plots with natural fertility of the soil and in fertilized seedbeds boosted the mineral nutrients intake by winter wheat plants.

The investigation of dynamic patterns of the leaf surface formation in winter wheat showed that the use of Terraflex had a substantial effect on the assimilation apparatusformation. It is also important to note that temperature andsoil moisture supply were one of the main factors that have an effect on the leaf surface area change in any crop including winter wheat. During the period of field studies the temperature regime and amount of rainfall in the whole period of vegetation were unequal and differed in the years of studies. This fact helped us study the problem comprehensively.

In conditions of 2011 – 2012 the assimilative surface in the tillering phase of the control group was 6, 64 thousandm^2/ha. The greatest leaf surface in this phase was formed due to the use of Terraflex that was 7,70 thousandm^2/ha. In the seed bed fertilized with NPKand NPKSthe values fluctuated from 8,84 thousandm^2/hato 9,68 thousandm^2/ha.

The analysis of data obtained that the area of winter wheat leaves augmented till the ear formation phase. The greatest values in this period were registered in the variant Terraflex (25,81 thousandm^2/ha) on plots withNPKS that supports the opinion of other researchers of a positive influence of sulfur on the assimilative surface of leaves and length of their functioning. Later the decline of photosynthetic surface of plants took place due to lower leaves' dying.

On average for the years of studies the leaf surface in the tillering phase varied in a range from 7,35to 10,21 thousandm^2/ha. The most intensive leaf surface gain in this phase was observed when Terraflex was used – 10,21 thousand m^2/hain the seedbed fertilized with NPKS. In the phase of shooting the leaf surface increased up to 14,75 thousandm^2/ha.

The situation with dry matter accumulation is similar to dynamic patterns of the assimilative surface of winter wheat leaves. The largest gain of dry phy to mass was noted from the shooting phase to the phase of milky and waxy ripeness. The similar trend was noted in all the years of studies. Later its accumulation took place mainly at the expense of generative organs of plants and reached a maximum value in the phase of complete grain filling which is linked to the outflow of metabolites from leaves into reproductive organs of winter wheat. Under the unfavorable vegetation conditions of 2014 – 2015 the dry biomass accumulation progressed less intensively in comparison with the previous years of studies. Insufficient quantity of rainfall at the beginning of crop vegetation and daily mean air temperature not exceeding 11 °C prevented the plants from forming a sufficient leaf area,consequently, the dry biomass accumulation value was not relatively high.

On average for the years of studies before harvesting the crop the amount of dry phytomass varied from 6,48 to 7,25 t/ha depending on the variant. Its largest accumulation towards the end of crop vegetation was formed in the variant of Terraflexon the plot fertilized with NPKS that was 7,25 t/ha.

The dynamic pattern character of leaf surface is reflected on the photosynthetic potential of plants and is subjected to the same natural laws. If the plants form leaves very quickly in the earliest phases of ontogenesis, they keep them in working order for a long time and they wither simultaneously enough after the ear formation phase then the photosynthetic potential of such crops will be big and the yield will be much higher[2].

The studies conducted showed that from the first days of vegetation and up to the ear formation phase the photosynthetic potential of winter wheat leaves grew quickly reaching the maximum value. Later, when the leaves of the lower tier become yellow and die it diminished. In the first year of studies in the phase of tillering –shooting the biggest value of the photosynthetic potential was registered in the variant Terraflex which was higher than in the control group by 14,3 %. The use of this preparation on the plot fertilized withNPK increased the value by 42,9 %, on the plot fertilized with NPKS – by 71,4 %. Maximum values were registered in the phase of ear formation –milky ripeness.

In the second year of studies the photosynthetic potential was higher than the values of the first and the third year that was connected with favorable meteorologic conditions. Asignificantinfluenceonthephotosynthetic potential in the phase of ear formation – milky-waxy ripeness both on the plot with natural fertility of the soil and in fertilized seedbeds was exerted by Terraflex where the values were higher than in the control group by 8,8 %. Such tendency with the photo synthetic potential was observed till the end of vegetation. The photosynthetic potential for the whole vegetation period was higher than in the control group by 24,2 %, depending on the studied options.

In the third year of studies in the phase of shooting in the variant Terraflex the photosynthetic potential was higher than in the control group on the plot without fertilizers by 26,1 %, on the plot with NPK – by 27,6 %, on the plot with NPKS – by 21,6 %.

On average in the years of studies the total photosynthetic potential of winter wheat leaves changed from 3,02 to 3,75 mln.m^{2}day/hain the course of plant ontogenesis. This indicator reached the greatest values in the option Terraflex on the plot with NPKS (3,75mln. м^{2}day/ha) and it is quite natural taking into the biggest assimilative surface of leaves in this variant.

The indicator of the photo synthetic productivity of plants is the dry mass accumulation by the plants in recalculation to a leaf surface unit for a certain period. These values are characterized by net photo synthesis productivity (NPP). This is a very flexible indicator that can be changed under the influence of many factors of the environment and plants' supply with mineral substances.

The largest NPP in the years of studies was in the phase of shooting – ear formation. On average for 2011 – 2015 the highest photosynthesis productivity was observed when Terraflex was used on the plot fertilized withNPKS, which amounted to 10,95gr/m^{2}a day. The lowest values of NPP were observed in the arid vegetation conditions of 2014 – 2015. Net productivity of photo synthesis was indirect dependence on the dry phytomass accumulation and in indirect – on the photosynthetic productivity.

Thus Terraflex preparation exerted a positive influence on the formation of the assimilative surface of winter wheat leaves and dynamics of the dry matter accumulation both under favorable and unfavorable climatic conditions.It contributed to a rise of the photosynthetic potential value and net photosynthesis productivity.

The purpose of intensive technologies isto realize the maximum potential yielding capacity of plants. It dependson major elements of the yield structure: the number of productive stalks on an area unit, the number of grains in an ear and their weight, an absolute grain weight (the weight of 1000 grains). The number of spikelets in an ear shows a maximum potential productivity which is possible in case of the favorable combination of all the factors that have an effect on growth and development of plants.

The structur alanalysis of the yield showed a positive influence of the used preparation on all elements of the yield structure both on the plot with natural fertility of the soil and on the plot with application of mineral fertilizers ofNPK and NPKS (table2).

The analysis of the winter wheat yield structure showed that favorable so i and climatic conditions of the vegetation period of 2013 – 2014 made it possible to form the greatest number of productive stalks and grains in an ear, and the greatest weight of grain in an ear and weight of 1000 grains. Unfavorable conditions of the vegetation periods of 2011 – 2012 and 2014 – 2015 contributed to the fall of quantitative values of the yield structure elements. In all the years of studies the application of mineral fertilizers and Terraflex raised the considered indicators.

On average for 2011 – 2015 the best results on the ear grain content were achieved when Terraflex was used on the plot with NPKS – 38 pieceswith the grain weight – 1,52 gr.

Thus the use of Terraflex in the technology of cultivating winter wheat promotes the implementation of the principles that are laid down in a genetic basis of plants for greater development of elements of plants' yielding capacity.

ISSN: 0975-8585

Table 2: Winter wheat yield structure

Variant	Number of productive stalks for m²			Number of grains in an ear			Grains weight in an ear, gr.			Weight of 1000 grains, gr.		
	2012.	2014	2015	2012	2014	2015	2012	2014	2015	2012	2014	2015
Non-fertilized plots												
Control	366,00	476,00	342,00	26,10	30,00	23,10	0,80	0,92	0,68	34,80	41,50	32,60
Terraflex	407,00	552,00	369,00	26,80	30,80	24,00	0,94	1,08	0,92	37,30	39,90	35,00
Plots fertilized with NPK												
Control	408,00	553,00	370,00	32,10	36,90	27,90	1,44	1,65	1,02	34,70	41,30	35,10
Terraflex	430,00	580,00	398,00	33,10	38,00	29,70	1,48	1,70	1,16	39,50	40,87	36,10
Plots fertilized with NPKS												
Control	432,00	581,00	397,00	33,80	38,90	31,80	1,41	1,63	1,17	35,30	41,20	36,00
Terraflex	468,00	602,00	418,00	37,00	42,60	34,40	1,51	1,74	1,30	40,60	41,30	38,30

The studies showed that soil and climatic conditions had a decisive influence on the yield size of winter wheat (table3).

In conditions of 2011 – 2012 the yield of winter wheat changed in the range of 2,46 – 3,47 t/ha. The biggest value in the state of natural fertility was detected in the variant Terraflex and amounted to 2,85t/ha. The use of the studied factor on the plot with mineral fertilizers (NPK) contributed to an increase of grain yield up to 3,39 t/ha. Maximum values in yields were achieved when Terraflex was used on the plot with NPKS – 3,47t/ha.

The climatic conditions of 2013 – 2014 were favorable for growth and development of winter wheat in comparison with the previous year ,due to which the grain yield was higher. In the control variant it was 3,60 t/ha. Foliage application of Terraflex contributed to the yield formation of 4,00 t/ha. Its application on the plot with NPK and NPKS increased the yield value by 0,5 – 0,6 t/ha.

The largest yielding capacity was formed under favorable conditions of the vegetation period of 2013 – 2014. The application of Terrafl exraised the yield of winter wheat in comparison with control variants in all the years of studies which is determined by the improvement of mineral nutrition of plants and a positive influence on the biomass gain because of the number increase of lateral stalks of winter wheat. This confirms the fact that the number of productives talks was more by 25 – 49pieces/m^2in comparison with the control variant ,that , ultimately, was reflected on the winter wheat yielding capacity.

Table 3: Grain yield of winter wheat, t/ha

Variant	Years of studies				Yield gain	
	2012	2014	2015	Average for 3 years	t/ha	%
Non-fertilized plots						
Control	2,46	3,60	1,96	2,67	–	–
Terraflex	2,85	4,00	2,11	2,99	0,32	11,99
Plots with NPK						
Control	2,76	4,00	2,31	3,02	–	–
Terraflex	3,39	4,50	3,01	3,63	0,61	20,20
Plots with NPKS						
Control	2,93	3,90	2,49	3,11	–	–
Terraflex	3,47	4,60	3,60	3,89	0,78	25,08

On average for the three years of studies the yielding capacity fluctuated from 2,67to 3,89 t/ha. The biggest yield gain was achieved in the variant Terraflex NPKS (0,78t/ha).

The grain quality depends on a complex of factors: meteoro logic conditions, soil types, agricultural practices, fertilization systems ,varietal qualities of seeds. It does not often meet the requirements set for it. The reason of this is unstable soil and climatic conditions of the Ulyanovsk region. In the course of studies we have found that the action of the studied factor is not limited by the yield increase but it also has a positive influence on the most important indicators of the winter wheat grain quality.

The amount and quality of protein in a plant depends on many factors and asour studies have shown the weather conditions of the vegetation period have a great significance, especially in the period of grain filling. The results of studies(table 4) demonstrate that the preparation used contributed to the quality indicators'improvement of winter wheat grain. The protein content in the grain of winter wheat increased by 1,94 % on plots with natural soil fertility, by1,77 % – on plots withNPK, by2,23 % – on plots with NPKS.

One of the indicators of bread-making quality of grain is the mass fraction of gluten and its quality. The massfraction of gluten is connected with the amount of protein substances. The complex of gluten's physical properties is thought of as the gluten quality: extensibility, resilience, plasticity, viscosity, cohesion, ability to preserve physical properties with time.

Table4:Indicators of winter wheat quality grain(mean values for 2011 – 2015)

Variant	Protein, %	Mass share of gluten, %	Index of gluten deformation, units.
Non-fertilized plots			
Control Terraflex	13,56 15,50	32,00 36,20	47 66
Plots fertilized with NPK			
Control Terraflex	14,48 16,25	34,40 38,80	64 70
Plots fertilized with NPKS			
Control Terraflex	14,93 17,16	35,30 43,01	72 72

The gluten content in winter wheat grain on average for the three years of studies varied from 32,0 % (Control) to 43,01% (Terraflex NPKS). The gluten quality in this case corresponded to group I and was equal to 72 units of the gluten deformation index. Thus Terraflex in all the years of studies had a positive influence on the yielding capacity of winter wheat both in favorable and unfavorable yearson agro-climatic conditions. Activationoftheproductionprocess contributed ultimately to the quality grain improvement.

Conclusions

The preparation Terraflex studied in our experiment contributes to the mineral nutrition intensification, plant adaptation toun favorable environmental conditions, the yield increase and quality of the produce grown. Its effectiveness goes up when mineral fertilizers are usedon the option withNPKS.

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