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A process for Stimulation of growth and development of "allantoin" type plants

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This invention relates to the treatment of plants with the intention of improving the useful characteristics of those plants which are important for humanity and for the existence of people on earth, that is to say for the improvement of qualities of the so-called cultivated plants. The concept "improvement of the useful characteristics of cultivated species" is to be taken as signifying the improvement of stimulation status of the cultivated plant but should also cover the indirect effects on other ecology conditions which in that sense are positive, such as, for example, the inhibition of competitive weed varieties, namely the directing of interaction in an ecosystem and the role of action and interaction towards the intensity and direction of natural selection as well as the character and scope of the process of plant speciation.

It is well known that important results in the suppression of weeds in field cultivation have been scored by using herbicides. The use of herbicides, as a specific kind of pesticides, is based on an action affecting a plant species, and turns to account the knowledge obtained through observing the effect of a particular chemical substance on agrobiocenoses as ecosystems, and it suffices if such an action turns out to be without effect on other components of the ecosystem.

Regardless of whether the absence of effect is shown by way of determination of the period of application or by way of selective determination of the components of the ecosystem under treatment, all the results are chiefly based on the observation of a particular one way action. Therefore one of the main purposes of this invention is to use, in an ecosystem, the new chemical substances which shall have not only active but also a wider interactive significance in the ecosystem itself. In other words, this invention offers the possibility for an analytical observation not only of plant cultivation but also of the whole system: substrate plant-weeds-ground-climate, and to direct interaction in a system thus defined.

It is also well known that the specific action of herbicides on the weed species stimulates the growth of the cultivated plants, solely by providing that, through the extermination of weeds, the competition between plants for space and the basic growth factors - water, nutritive salts and light -is shifted from the natural equilibrium created by conditions naturally existing in this bivariable system, towards a favorable situation for the cultivated plant. Nature, however, always constitutes a multivariate system, where the stimulation of a particular species is necessarily effected not only through the extermination of the competing species but also through stimulated growth of the plant the favoritism of which is presented as the ultimate aim. As competition between two plant species is all the more intensive if these species have similar ecological requirements and in so far as the capacity of the environment is limited, it is evident that significance must be attached to the proper direction of interaction in the ecosystem under treatment. Therefore, a further aim of this invention is to use a chemical substance not only to influence selectively a component of the system but also, by employing this material, to achieve a definite direction of interaction towards the favoring of the cultivated plant through its own phytologic development.

It is also well known that by the action of particular chemical substances it is possible to influence different parts of the plant. The use of these substances calls for a definite combination of the chosen substances as well as the moment of use. The best known method is the use of basic elements which the plant takes from the ground and utilizes in its vegetative period; for the stem and leaves, but also for accumulation of the different useful ingredients of the yield. Many such substances are known, their aim being to provide different effects, but such substances will also be useful to the weed plant if both species have similar ecological needs as the action of competition is as a rule more or less unfavorable for both competitors. A further aim of this invention is the use of such stimulative substances in the process of plant growth stimulation, as will at the same time stimulate the cultivated plant and inhibit the weed plant alongside it.

It is also well known that specific substances which are used as fertilizers belong to the previously mentioned group which exercise an influence on the development of different parts of the plant. Thus, for example, the introduction of phosphorus, potassium and nitrogen through the use of Chilean saltpeter or superphosphate, does not equally influence the growth stimulation of all the parts of wheat. It has been established that the average values for coleoptile remain unchanged in the case of both fertilized and unfertilized wheat, while the average value of the length of the first and second wheat leaves grown on manured black earth was by about 44% higher than the average length of the first and second wheat leaves grown on manured surfaces. It is particularly interesting, therefore, to get such a substance which will stimulate the development of all sections of the plant, but particularly act on the growth of coleoptile. This is particularly significant also in view of the period of treatment, as growth of coleoptile could also be influenced in the phase of the heterotrophic nourishing of the plant. Therefore, the further aim of this invention is to use, in the process for stimulation of the plant growth, such a substance as will influence also the initial period of the plant growth, with a specific effect on the coleoptile. This aspect of the invention provides the possibility of application before contact with the substrate. Furthermore, the realization of this aim provides an opportunity for using the growth stimulation process for industrial purposes, for example in such processes as are based on the development of plants products in the heterotrophic nourishment period.

Investigation of the exogenic role of the stimulating substance which is also the object of this invention, has shown that it could be used for a great variety of plant species. For example, it has been established that its effect, in the sense of the improvement of the stimulation status, is reflected on wheat, corn, sunflower, beetroot, clover and on other plants differing in genus, family and class. But besides this wide variety of plant species, there exists a distinct trait which can determine the ecological category of plants sensitive to the use of the substance for the improvement of the stimulation status according to this invention. It is based on the substantial observation of the biosynthesis in the plant itself and evaluation of the role of the phytocenologic chemical factor on a definite ecologic category. In view of this examination, it may be said that, according to the invention, it is possible to influence the stimulation status of plants of such ecologic category as could be called the "allantoin" type. This category includes:

Triticum vulgare, Agrostemma githago, Anchusa officinalis, Borago officinalis, Sinphitum officinalis, Beta vulgaris, Lactuca sativa, Lepidium sativa, Raphanus sativa, Sinapis nigra, Cucumus sativus, Cucurbita sp., Avena sativa, Hordeum vulgare, Oryza sativa Secale cereale, Zea mays, Sorghum halepense, Alium sp., Corronila varia, Glycina hispida, Lotus cornicutatus, Lathyrus silvestris, Mellilotus alba, Melilotus officinalis, Phaseolus vulgare, Pisum sativum, Trifolium pratense, Trifolium sativum, Vicia hirsuta, Vicia lu eha, Vicia sativa, Nicotiana tabacum, Solanum tuberosum, Tilia silvestris, Daucus carrota, medicago sativa, Canabis sativum, Humulus lupulus, Urtica dioca, Capsacum anuum and others.

A further feature of the invention under review is that the improvement of the stimulation status when the interaction of the plant organisms forming a natural community of cultivated and weed plants is involved, affects only the cultivated plant, which is actually one of man's basic tasks in influencing the natural communities of this kind. It has been established with surprise that when the stimulating substance under this investigation is applied to such communities consisting of weeds and cultivated plants, the stimulating effect is to be observed only on the cultivated plant and, as stated earlier, on all parts of the plant. Thus the discovery relates to the improvement of the status of cultivated allantoin kind of plant when they grow in community with weed plants and in the case when those weed plants growing together with the cultivated plants are also of the allantoin kind.

In view of the aforesaid, this invention relates to the improvement of the stimulation status of cultivated plants of allantoin kind, when growing in community with weed plants and even when these weed plants also belong to the allantoin kind. Therefore, in its narrower sense, the invention provides for the improvement of stimulation of growth in the following plants:

Tritucum vulgare, Beta vulgaris, Lactuca sativa, Raphanus sativa, Sinaphis nigra, Cucumus sativus, Avena sativa, Hordeum vulgare, Oryza sativa, Secale cereale, Zea mays, Alium sp., Glycina hispida, Lathyrus silvestris, Phaseolus vulgaris, Pisum sativum, Trifolium pra-tense, Nicotina tabacum, Solanum tuberosum, Tilia silvestris, Daucus carrota, Canabis sativum, Humulus lupulus, Capsacum annum and others.

It goes without saying that the concept of cultivated and weed plant species should be understood as previously precisely stated, that is, when a corresponding community is in question. As this criterion is only relative and based on the existing categorization, the relations between the plant system and human needs being as they are, the invention should be taken in its broadest sense as pointed out at the beginning. Thus it should be borne in mind that a plant which is considered a weed, could be treated also as a cultivated plant if necessary and that in such a case, in keeping with the invention, it would be possible to influence such a plant too, with a view to improving stimulation of growth, if it belongs to the above mentioned allantoin kind.

It is a well-known fact that mineral fertilizers are used as a nutritive agent, consisting chiefly of phosphorus, nitrogen and potassium. However, for the effective utilization of these elements, their absolute quantity is not alone to be considered significant, but also the form in which these elements are to be found in the substrate. For these reasons it is essential to establish the most favorable ratio of the compounds present in the applied fertilizer to be effectively used for the nutrition of the plants. It is well known that this fact for phosphorus can also be established by chemical analysis of the easily soluble phosphorus in the form of P_2O_5 by the Enger's lactate method using Lange's colorimeter. It has now been established, surprisingly, that the use of the substances according to the invention, when the soil is being treated, considerably increases the content of soluble phosphorus in the soil. Normally, the compounds of the invention are introduced into the soil by way of water or seeds, out could also be introduced by some other carriers which might be inert in relation to the plant or might have some definite value, for example pesticides or fertilizers with which these substances may be combined.

It has now been found that all the mentioned aspects could be realized by the use of definite chemical substances which possess definite properties as regards their chemical structure which is of importance for the stimulation of the plant growth. These chemical substances belong to a broad spectrum of substances. Bearing in mind the processes of the physio-biological character, it is evident that the broadness of the above-mentioned spectrum of substances is governed by the capability of the biosystem to synthesize macromolecules as well as the capability to use ready-made synthetic macromolecules. The chemical substances which can be used according to this invention as macromolecules belong to the group of ribonucleic acids and dezoxyribonucleic acids. These substances take part in basic biochemical processes. Nucleic acids provide for the synthesis of proteins and those substances which are the upholders of hereditary characteristics in the organism.

Nucleic acids are macromolecular substances with an acid function and are composed of very complex molecules which could be classified as carbohydrates, a basic component which contains nitrogen and phosphoric acid. The carbohydrate component of the macro molecule is aldopentose. Further, the part of the molecule which could be classified as a carbohydrate, is, therefore, constituted by D-ribose and D-desoxyribose.

Phosphoric acid presents the simpler part of this macro-molecular compound which, in degradation, appears in the form of a phosphate ester of the carbohydrate.

The basic component which contains nitrogen belongs to the group of heterocyclic compounds.

Of the heterocyclic compounds appearing as basic components in nucleic acids, those which might be described as purine and pyrimidine derivatives, should be specially underlined.

Nucleic acids as chemical compounds could be classified as belonging to the group of macro-molecular compounds. Molecular weight of these macromolecules could vary to a considerable extent. By the method of diffusion and by centrifuging, the values obtained for dezoxyribonucleic acid from the thymus gland were 500,000 to 1,000,000 and even more. For ribonucleic acid from yeast the values obtained were between 6,500 and 290,000.

The constituent parts of nucleic acids are nucleotides. They could be considered as the derivatives of nucleosides obtained by esterification of those with phosphoric acid. Bearing in mind the structure of nucleosides which are differentiated from the basic, nitrogen containing component, and could be considered as an essential unit, it is possible to compare the nucleic acids with copolymers of different monomers which, in keeping with their constitution, are called mononucleotides. Different mononucleotides could be found incorporated in a macromolecule of the nucleic acid, and their numerous combinations in the macromolecule provide possibilities for the formation of a complex system of these exceptionally important substances for living matter.

It is well known that the nucleic acids are synthesized biologically in living organisms, and the conclusions regarding these biosynthesis are made on the basis of various indirect methods such as the fermentative synthesis, which is carried cut by using ferments in extracellular environment. The mechanism of the biosynthesis, however, is not quite determined, particularly of the nucleic acids have occurred through synthesis in plants. On the basis of the present situation in science in this field, some light could be cast here on the basis of catabolism of nucleic acids. It is hardly possible to make any suppositions regarding the exact mechanism of degradation of nucleic acids "in vivo", but available data show that ribonucleic and dezoxyribonucleic acids are in the beginning hydrolyzed by a corresponding enzyme and the products of their degradation are transformed into mononucleotides which, through the action of various phosphates are converted into nucleosides. The individual purine and pyrimidine nucleosides are then further degraded.

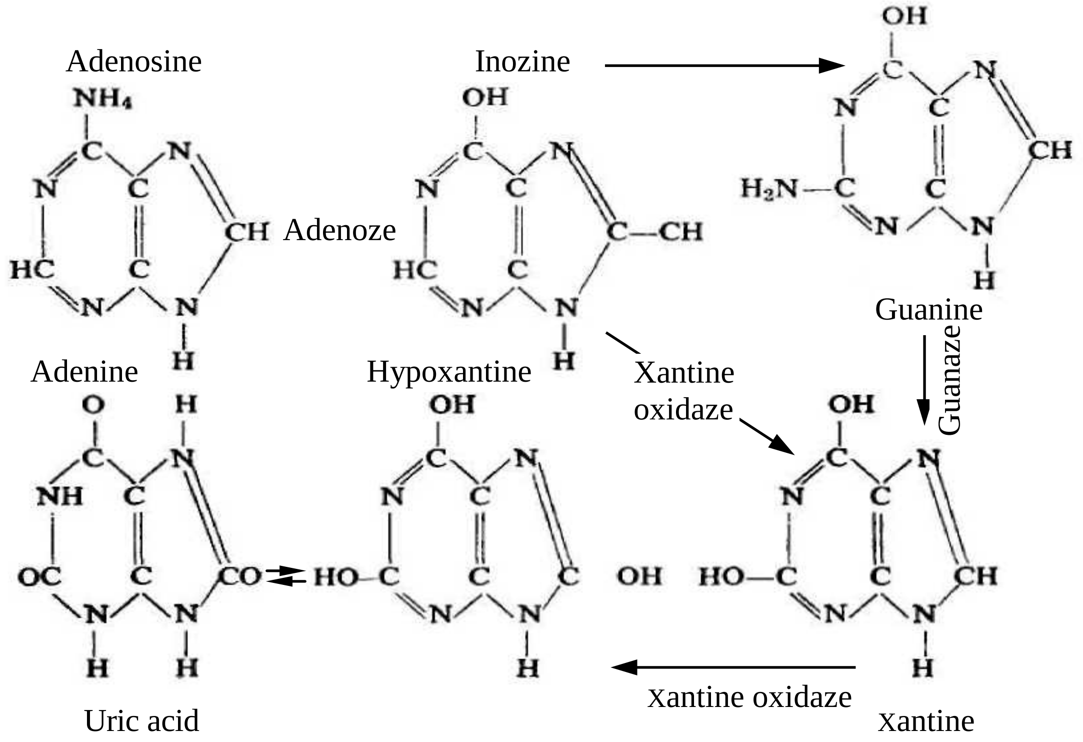
Nucleic acids which are introduced into the living organism with food, are degraded in the intestines by the action of nucleases which are formed in the intestines and the pancreas. Phosphoric acid, free bases and possibly carbohydrates are simultaneously liberated. Purine and pyrimidine bases are further transferred to blood and could either be used for synthesis of nucleotides and nucleic acids or degraded into various chemical compounds. The degradation on the nucleotides, nucleosides and base level could be schematically presented as follows:

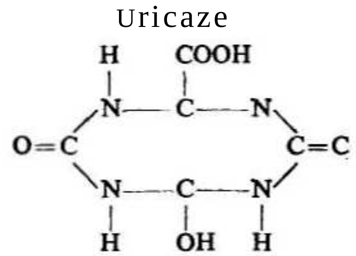
$$\begin{array}{ccc}
\text{adenosine monophosphate} & \rightarrow & \text{inosine monophosphate} \\
\downarrow & & \downarrow \\
\text{adenosine} & \rightarrow & \text{inosine} \\
\downarrow & & \downarrow \\
\text{adenine} & \rightarrow & \text{hypoxantine}
\end{array}$$

$$\begin{array}{ccc}
\text{xantosine monophosphate} & \leftarrow & \text{guanosine monophosphate} \\
\downarrow & & \downarrow \\
\text{xantosine} & \leftarrow & \text{guanosine} \\
\downarrow & & \downarrow \\
\text{xantine} & \leftarrow & \text{guanine} \\
\downarrow & & \\
\text{uric acid} & &
\end{array}$$

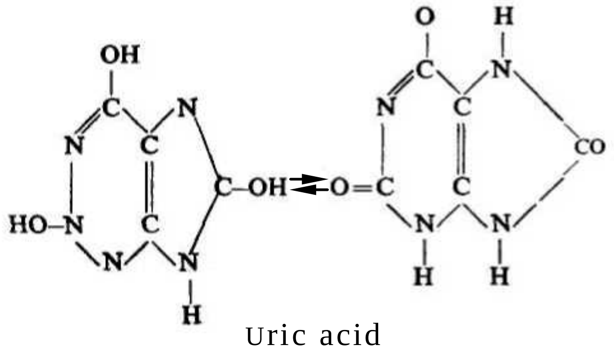
In organisms where the ferment uricase is also present, the uric acid is oxidized to more soluble allantoin and other end products, under specific conditions. Catabolism of nucleic acids has been studied more extensively in animals, starting with the most developed species down to the simplest, but the catabolism of plants is less known. The existence of the allantoin derivatives proves that the metabolism, of plants is of such a nature that it is possible for uric acid to be oxidized further to allantoin and perhaps to still further degradation products. In the above mentioned plants, for instance in the seed of *Agrostemma githago,* allantoin could be found among other substances.

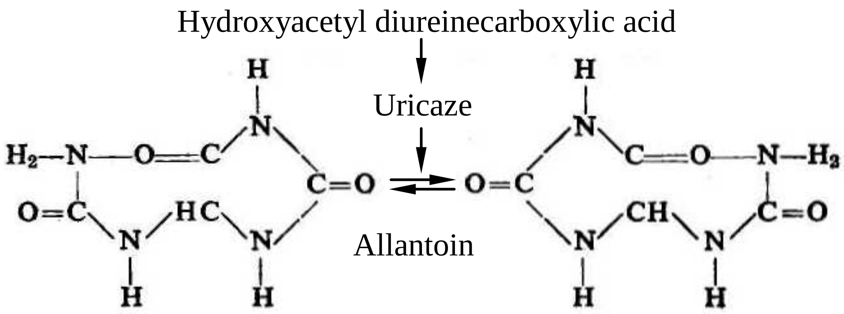
The scheme of the chemical degradation of purine, respectively its derivatives, could be presented as follows:





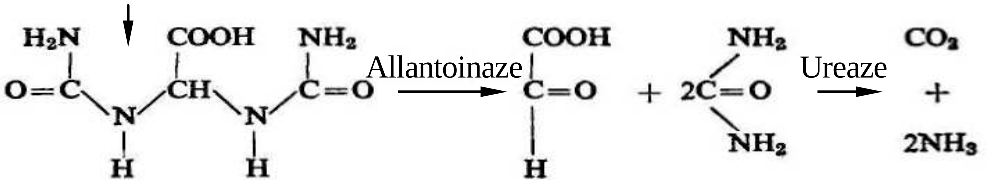
By the action of uricase, the catabolism of the uric acid is continued through allantoin acid, glyxalic acid to urea, carbondioxide and ammonia. The chemical scheme of these reactions runs as follows:





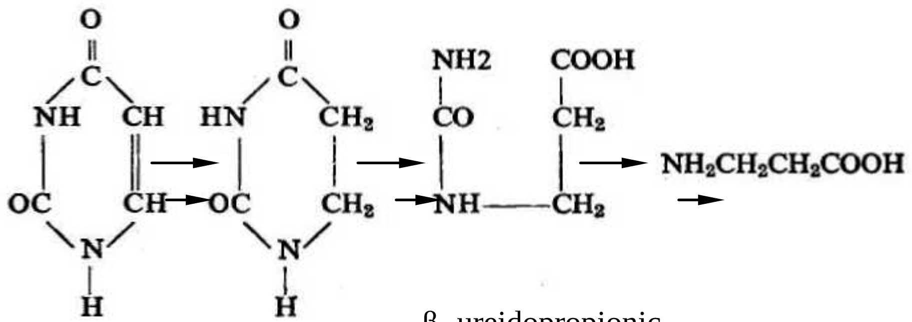
and further: Allantoin

Allantoinaze

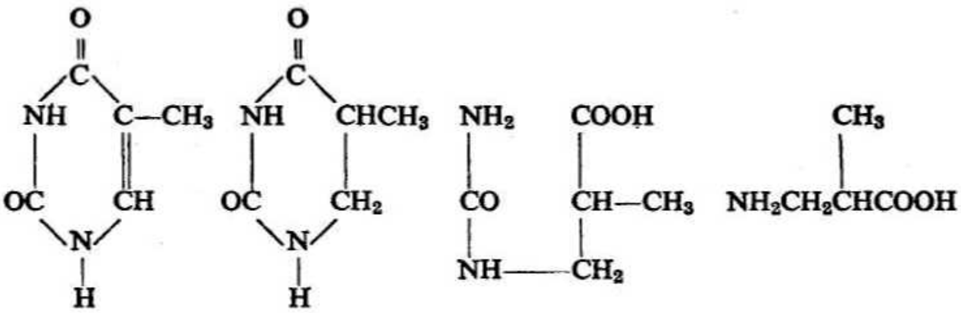


Allantoin acid Glyoxalic acid Urea

On the basis of the catabolism of pyrimidine, the next fundamental substances are obtained, which might also participate in synthetic reactions occurring under specific conditions which govern plant and animal life. Catabolism of uracile and thymine concerns the reduction of pyrimidine to dihydro derivative, destruction of the ring and the formation of corresponding ureidoacids and liberation of ammonia and CO_2, so that, as a result, β - alanine or its methyl substitutions are obtained. The reaction course is as follows:



Uracil Dihydrouracil β -ureidopropionic acid β -alanine



Thymine Dihydrothymine β - ureidoizobutyric acid β - aminoizobutyric acid

Without taking into consideration the complicated system of biosynthesis "in vivo", which should be the subject of a separate study, this invention is based on the possibility of using the improved stimulation of plant growth in agricultural practice. Besides the aforementioned action of ribonucleic and dezoxyribonucleic acids, the ecological system is also actively influenced by the substances which appear as catabolic products of purine and pyrimidine component parts of nucleosides in various stages of their decomposition. However, as they are utilized in agriculture in different stages of their decomposition, the invention will be separately presented in relation to those possibilities which occur when the simplest products of catabolism are used. The invention is not limited to this as, according to experimental data on this subject, the positive effect on plant growth stimulation of allantoin species has been established both for nucleic acids as complex systems and for their component parts which are formed in advanced degradation phases. Figuring as these final substances, are allantoin, allantoic acid, adenine, alanine and glycine.

The tests made were both of the laboratory type and those where plots of agricultural soil were treated. During the tests a distinctive difference was noted regarding the influence on plant growth stimulation when different qualities of soil were used. For this reason the results obtained on the substrate of black earth and humus type have been set forth. As regards field tests, these were performed in various climatic conditions.

Concerning the application of substances previously mentioned there are no specific conditions which might greatly influence the ultimate results. As shown in the examples, application could be performed with success on the seed itself without substrate so that the action and effect of stimulation has been observed in both the germination period and later. Application could also be carried out by the foliar method through the leaves of the plant and in all vegetation periods inasmuch as it could be observed that there is a change in stimulation intensity dependent on the period of degradation as in the case of clover. Finally, the application could be performed by introducing, in the substrate itself, the soil on which the cultivated plant is to be grown, and this in different forms. Introduction into the substrate could be made directly with the water solutions of stimulating materials themselves, water solutions of their mixtures, or the mixtures of those active substances with some other materials used in agriculture. It is possible to apply these materials also with solid carriers. Various pesticides or fertilizers might be used as these latter materials and can be added in the usual way to the plants.

In the text that follows, the examples presented will show the quantitative effect of the added substances on the growth stimulation of allantoin type plants, constituting the established action which is the subject of this invention. This will be done by way of examples where the percentage content will be given in weight rations, temperature in degrees centigrade, if not otherwise stated.

Example 1.

Plots of 10 to 35 ha were sown with corn. The plots used for experiments were divided in such a way that control could be exercised under the same conditions. Hybrid species NSSK-70, $VR_{0X}N6$, ZPSK-6, ZPSK-4, $FV_{9X}N6$ were treated. Treatment was foliar, carried out at the end of May and beginning of June, with 0.33% water solution of allantoin to which was added 0.7 g per 1,000 l of the mixture containing 27.5% allantoin, 5.0% adenine, 2.5% folic acid, 2.5% alanine, 2.5% arcip-lanine, 12.0% tryptophan, 15.0% glycine and 33.0% allantoic acid. At harvesting, the yields on treated and untreated plots were separately weighed and 40 corncobs were measured for evidence of length circumference, number of grain rows. Yields obtained are given in Table 1.

Table 1.

Hybrid	Treated surfaces		Untreated surfaces		Increase Yield in %
	surface	yield per 1 ha	surface	yield per 1 ha	
NSSK-70	36,00	7990	21,80	7450	7
$VF_{9X}N_6$	21,50	7999	11,80	6330	26
$VF_{9X}N_6$	12,00	6710	21,70	5400	24
ZPSK-4	8,20	7556	32,80	6860	13
ZPSK-6	14,00	7213	27,00	6165	16

By comparative investigation, i.e. analysis of amino acids in the corn grain, it has been established that the stimulating effect is not reflected only in the increase of yield, but also in the quality of the product obtained. Analysis of 100 g of flour obtained from the treated plants showed that an increase of amino acid content occurred, for hybrid NSSK-70 - 24%, increase of amino acids (tryptophane) plus 19% increase of true protein and for hybrid $VF_{9X}N6$. The increase was 17% tryptophan, compared with the quantities in the flour obtained from untreated plants.

Example 2.

The soil treated according to Example 1. was subjected to agrochemical analysis, in order to determine readily available phosphorus in the soil. The content of soluble phosphorus in the form of P_2O_5 was determined by the Engler's lactate method with Lange's colorimeter. Results of these analyses are supplied in Table 2.

Table 2.

Hybrid	P_2O_5 in mg per 100 g of soil		Increase	
	treated	untreated	mg	%
NSSK-70	29	19	10	52
ZPSK-4	32	24	8	33
ZPSK-6	38	27	11	40
ZPSK-4	27	21	6	28
Average results	31	22	9	40

* from the other plot.

Example 3.

The black earth fields in the continental climate region were sown with wheat previously treated with a substance belonging to the system of ribonucleic and dezoxyribonucleic acids. During the experiment the analysis of the production of seed under close packing conditions was performed and compared with the control untreated with the mentioned substances as the growth stimulation activator. If 100% designates the yield of one vegetation year, then the yield of treated wheat amounted to 157%, while in the next vegetative year the increase amounted to 170%.

Example 4.

The wheat seed obtained in the first vegetative period in Example 3. was sown in close packing conditions, alongside with the untreated seed in black earth type of soil under continental climate conditions. At the time corresponding to the second vegetative period according to Example 3, the obtained yield amounted to 147 % compared to the yield of untreated wheat from the first vegetative period in Example 3 which was taken as 100%. This example shows that the stimulating condition continues in the first generation.

Example 5.

The black earth soil under the continental climate conditions was seeded with wheat treated with a mixture containing 27.5% allantoin, 5% adenine, 2.5% folic acid, 2.5% alanine, 2.5% orcialanine, 12.0% tryptophane, 15% glycine and 33.0% allantoic acid in a quantity amounting to 7 kg/ha. Compared with the control, whose yield is designated as 100% and amounted to 4,745 kg/ha with hectoliter weight of 87.5, the treated field gave a yield of 5,368 kg/ha of grain whose hectoliter weight was 87.5. The increase of yield per hectare as a result of wheat being treated with the above-mentioned mixture amounts to 114.37%.

Example 6.

A sugar beet plant culture was set on a test plot when a surface of 17.0 ha was foliarly treated with the same substances as in Example 1. Compared, with the untreated plot of 20 ha, the obtained yield increase was about 12%, as the total yield on treated surface amounted to 680,230 kg, that is about 40,000/ha while on the untreated plot the total yield was 710.000 kg, or 35000 kg/ha. Thus, not only was the mass of sugar beet increased in these experiments, but also the quality was improved, as expressed in the augmentation of digestion. The digestion was 12% for the control and for treated plants 16.6. At the same time the earth under the plants was analyzed and the P_2O_5 content in easily soluble form was established. In the untreated sugar beet fields, the content of easily soluble phosphorus amounted to 28 mg per 100 g of soil while in the soil below the treated plants it was 40 mg per 100 g, of soil. The increase in P_2O_5 of 12 mg per 100 g of soil or 42% is the result of applying the mentioned substances for plant stimulation.

Example 7.

Differently situated plots were treated along with the untreated control plots. The treatment of sugar beet was carried out as in Example 6, but considering the commercial importance of this plant, particular emphasis was put on the digestion of the cultures involved. The results of these teats are given in Table 3.

Table 3.

Sample treated root		Digestion	B_x	Ash	"Blue number"
Treated					
1	24,5	13,6	17,4	0,903	111
2	27,5	13,6	17,2	0,850	111
3	22,5	15,0	18,6	0,710	77
4	25,0	14,6	18,2	0,720	77
5	27,0	13,6	17,0	0,750	83
Average		14,14	17,6	0,786	91
Untreated					
1	35,0	13,0	16,6	0,880	111
2	26,0	13,0	16,6	0,835	111
3	33,5	12,8	16,2	0,800	123
4	26,5	12,8	16,4	0,880	115
5	32,5	12,2	15,8	0,890	115
Average		12,7	16,3	0,857	115

Example 8.

The tests were performed with wheat grown on marsh humus in vessels which were kept under field conditions. The plants ware treated immediately after seeding indirectly by watering the substrate with folic acid water solutions whose concentration was 0,1 mg/l. The percentage of germination was determined, at the end amounting to 100% for treated and 90% for the untreated plants. The number of spikes in the treated plants was increased, if designated for untreated plants as 100%, it amounted to 150% for treated plants.

Example 9.

Tests were performed on wheat in the same manner as in Example 8., only instead of aqueous solution of folic acid, the aqueous solution of glycine of the same concentration was used. The germination percentage at the end of sprouting amounted to 98%, and the content test gave germination of 90%. The number of ears on the treated plants, if on the untreated designated as 100%, amounted to 130% as compared with the untreated.

Example 10.

Tests were performed on wheat, in the same way as in Example 8., only instead of the aqueous solution of folic acid the aqueous solution of adenine of the same concentration was used. The germination percentage at the end of sprouting amounted to 93% and the control test gave 90%. The number of ears of the treated plants amounted to 160% if the same is designated as 100% for the untreated plants.

Example 11.

Tests were performed on wheat, only instead of the aqueous solution of folic acid, the aqueous 1:1:1 mixture of folic acid, glycine and allantoin, the water concentration of which was 0.1 mg/l was used for treatment. The germination percentage at the end of germination amounted to 93% for treated plants as compared with the germination of the control which was 90%. The number of ears in the treated plants was 130% if the same for the untreated is designated an 100%.

Example 12.

Tests were performed on barley in vessels kept under laboratory conditions in thermostats at 25°C. The seed was sown on wet filter paper support and watered with aqueous solution of alanine whose concentration was 1 mg/l. Germination energy expressed in EK units for treated plants was 20 and for untreated 17.5 EK. The end germination for treated plants was 100% and for the control test 90%.

Example 13.

A clover culture on a test field was used. A plot of 100 ha was treated by a foliar spray as in Example 1. Compared with the untreated plot which was likewise 100 ha, the obtained mass increase amounted from 60% to 335%. Variations in mass increase for clover depends on the period of application, i.e. on the age of the plant.

Example 14.

In a separately performed test with clover, which was treated as explained in Example 1., the soil under clover was analyzed and the content of easily soluble phosphorus and of potassium in the form of oxide has been determined. The results obtained are given in Table 4.

Table 4.

	In mg per 100 g of soil		
	treated	untreated	increase
P_2O_5	40,0	32,5	7,5
K_2O	47,7	22,6	25,1

Example 15.

The laboratory test were carried out on paprika plants. The seed was sown in Petri-dishes on wet filter paper and watered with the solution described in Example 1., and was kept at 25°C in a thermostat. The germination percentage at the end of sprouting was 96% for treated plants, while for the control it was 81%.

Example 16.

Sunflower culture was placed on a test field. A surface of 18 ha was treated by foliar spray with a solution as described in Example 1. Compared with the untreated plot of 9.3 ha, the yield increase of 23% was obtained, as the total yield from the treated plot amounted to 41,492 kg or 2,279 kg/ha and from the untreated part 17,066 kg or 1,850 kg/ha. At the same time the analysis of soil under the sunflowers was performed and the soluble phosphorus content was determined. In the treated plot the soluble phosphorus content was 35 mg/100 g of soil. Analysis of the sunflower on oil gave the following results: percentage of oil in treated plants was 47.80% and in untreated 43.75%, and it is evident that the increase of 4.05% was due to treatment of sunflower with solutions of plant stimulating substances.

Example 17.

Tests with barley in Petri-dishes under laboratory conditions were performed. The seed was sown on wet filter-paper support and watered with the aqueous solution of tryptophane the concentration of which was 0.1 mg/l, and kept at 25°C in a thermostats. Germination energy expressed in EK units was 23.0 for treated, plants, and 17.5 EK for the untreated. The end germination for treated plants was 92%, and for the control test 80%.

C L A I M S

1. A process for stimulation of plant growth, characterized in that the allantoin type plants were treated with substances belonging to the system of ribonucleic acids, dezoxyribonucleic acids, their degradation, products before being placed on the substrate or, in the course of autotrophic or heterotrophic period of nourishment.

2. A process according to Claim 1, characterized in that the intermediary degradation products of ribonucleic acids and dezoxyribonucleic acids are used as substances which stimulate the growth of plants.

3. A process according to Claims 1 and 2, characterized in that, as degradation products are used, the catabolic products of purine and pyramidine parts of nucleosides in different stages of their degradation, these end-degradation products which are used, being allantoin, allantoic acid, orcialanin, alanine, glycine, tryptophan and folic acid.

4. A process according to Claims 1 to 3, characterized in that the stated substances act on the plants of allantoin type as well as on the plants designated as citrulinic, glutamic, lysinic and allantoic acid types, particularly the plants *Triticum vulgare, Beta vulgaris, Lactuca sativa, Raphanus Sativa, Sinapis nigra, Cucumussativus, Avena sativa, Horedum vulgaro, Oryza sativa, Secale cereale, Zea mays, Alium Sp. Grlycina hispida, Latirus silvestris, Phaseolus vulgaris, Pisum sativum, Trifolium pratense, Nicotina tabacum, Solanum tuberosum, Tilia silvestris, Daucus carrota, Canabis sativum, Medicago sativa and Humulus lupulus, sp. Capsecum anuum.*

5. A process according to Claims 1 to 4, characterized in the plants were treated with the mentioned substances for growth stimulation directly by acting on the plant seed or foliarly during the plant growth.

6. A process according to Claims 1 to 5, characterized in that the mentioned substances used for plant stimulation act on the substrate on which the treated plant is grown, and in this way the stimulating substance in introduced in the plant by way of the roots.

7. A process according to Claim 6, characterized in that the seed treatment was performed away from the substrate.

8. A process according to Claim 1 to 7, characterized in that the stimulating substances act separately or in mixtures, so that they act on the plants or their seed directly or by way of the substrate in the form of aqueous solution or through other carriers which may be inert or active towards the plant (fertilizers, pesticides, herbicides).

9. A process according to Claims 1 to 8, characterized in that the effects achieved by the action on the plants through the use of stimulating materials are also transferred to subsequent generations without a repeated treatment of these late generations.

10. A process according to Claims 1 to 9, characterized in that the treatment of the substrate with the stimulating substances increase the content of easily soluble phosphorus.

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