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The influence of humates produced by "Shubarkol Komir" JSC on the germination of seed material of various vegetable crops

The biological activity of humid substances is manifested in increasing the resistance of plants to unfavorable factors and stimulating their metabolic processes, which has a positive effect on the growth characteristics of both seed material and the vegetative part of the whole plant. The article examines the influence of humates produced by "Shubarkol Komir" JSC during pre-sowing soaking on the germination of seed material of various cultivated plants, and assessed their antifungal activity. Commercial humates "Ideal", "Gumate 7+", and "Biomaster" humates were used as comparison preparations. In the experiments, seed material of the following crops and varieties was used: tomato, Siberian Yabloko variety; eggplant, Caviar Paradise variety; sweet pepper, D'Artagnan variety; water cress, Abundant-leaved variety; radish, grade "5+"; nut. For tomato and sweet pepper, the best content of humates in the solution for soaking seed material was 0.5%, for eggplant, watercress, radish and chickpeas – 0.1%. The effectiveness and antifungal activity of "Shubarkol Komir" humate is not inferior to commercial drugs used as reference drugs.

Keywords: humates, seed material, pre-treatment, germination, germination energy, antifungal activity.

Introduction

The following types of humates are distinguished depending on the predominant content of one or another element — potassium, sodium and enriched with microelements.

They offer three main ways to use new generation humates in crop production: applying the preparations directly to the soil with fertilizers, seeds, and watering; pre-sowing treatment of seed or other planting material, possibly in combination with fungicidal preparations; spraying green vegetative plants is also possible together with pesticides of various groups [1].

The biological activity of humates consists in their influence on the resistance of plants to unfavorable factors, as well as in the stimulation of metabolic processes, which leads to better growth characteristics, especially in the initial stages of plant development. This is due to the presence of mineral components and organic acids in humates, which contributes to the activation of plant growth processes and their protective mechanisms. Pre-sowing treatment of seed material reduces the development of bacterial and fungal infections of seedlings and adult plants.

Due to the intensification of agriculture, as well as difficult climatic conditions in the region, the use of humic preparations is becoming increasingly relevant and in demand [2–6].

Based on humates from weathered coals of the Shubarkol deposit, a humic fertilizer has been developed, which can increase the soil fertility of Central Kazakhstan, and also solves the problem of waste, since previously this group of coals was stored without use.

Evaluation of the positive effect of humates on indicators such as germination, germination energy of seed material, inhibition of the development of phytopathogenic mycoflora, will allow us to recommend the widespread use of this fertilizer produced by Shubarkol Komir JSC.

Experimental

The object of research was humates provided by "Shubarkol Komir" JSC, as well as commercial solutions of humates as reference preparations: humate "Ideal", "Gumate 7+", humate "Biomaster".

The tested humates produced by "Shubarkol Komir" JSC (hereinafter referred to as GS) were diluted in concentrations of 0.1%, 0.01%, 0.5%, 0.05% and 0.005%. Solutions of commercial humates were prepared according to the attached instructions.

The seeds of the following crops were taken into the experiment:

- tomato, Siberian Apple variety;
- eggplant, Caviar Paradise variety;

- bell pepper, D'Artagnan variety;
- watercress, Abundant-leaved variety;
- radish, grade “5+”;
- nut.

Before sowing, seeds were soaked for 24 hours in solutions of humates of various concentrations. Distilled water was used as a control. Experiments were carried out in quadruple repetition. Seed germination was assessed in laboratory conditions using standard methods [7–9]. Germination was carried out in Petri dishes on filter paper.

When germinating seed material, the degree of damage to seedlings and germinating seeds by fungal diseases was assessed. Thus, minor fungal infection (+) – damage to 5–10% of seeds and seedlings, moderate fungal infection (++) to 30% of seeds and seedlings; significant damage (+++) – from 30 to 50%; severe (++++) – more than 50% of seeds and seedlings are damaged.

Results and Discussions

The results obtained as a result of germination of seed material of various vegetable crops after pre-treatment in solutions of humates of various concentrations are presented in Tables 1, 2.

In tomatoes, the best results among comparison products were obtained with “Humate 7+” - 90.0% ± 4.5 germination energy and 100% germination rates. The same growth characteristics were obtained with solutions of Shubarkol Komir humates at a concentration of 0.5%. Control values are 15% less.

When pre-treating bell pepper seeds, the best results among commercial preparations were shown by humate “Ideal” — germination energy — 60.4%±3.3 and germination — 75.0%±2.37. The use of GS in a concentration of 0.5% led to the manifestation of better growth characteristics of pepper seed material, 83.0% ± 4.5 and 96.0% ± 4.62 germination energy and germination, which is more than 20% higher than corresponding indicators for the best comparison drug considered. If we compare the data obtained with the drug “Gumate 7+”, then the growth characteristics after treating seeds with GS 0.5% will be 7.5 and 6 times higher, respectively.

The eggplant seed material of the Caviar Paradise variety showed the lowest germination energy and germination rate of all the studied cultivated plants: 22.3%±0.99 and 36.0%±1.3, respectively. The most effective of the commercial humate solutions used, “Biomaster,” increased the growth performance of eggplant seed material of the studied variety to 35.0% ± 1.06 — germination energy and up to 50.5% ± 1.5 — germination. Indicators comparable to these data were obtained when seed material was treated with Shubarkol Komir humate at a concentration of 0.1%: 36.3±1.3 — indicators of germination energy and 54.5±1.5 — germination. A decrease in the content of humates in the solution for pre-treatment of seeds led to a decrease in growth characteristics, but not below control values.

Table 1

The influence of different concentrations of humates on the energy of germination of seed material of the studied crops

Experience option	Tomato	Sweet pepper	Watercress	Radish	Eggplant	Chickpeas
GS 0,1%	75,4±3,2	65,4±2,9	55,5±1,78	100,0	36,3±1,3	52,5±1,66
GS 0,5%	89,6±4,6	83,0±4,5	52,5±2,6	20,0±0,14	26,8±0,4	46,0±0,8
GS 0,01 %	77,3±3,5	25,5±1,2	72,5±4,75	58,0±1,3	30,3±1,8	48,2±1,9
GS 0,05%	80,2±3,3	58,3±2,2	70,0±6,67	65,0±3,4	26,3±0,3	50,0±1,71
GS 0,005%	55,8±2,5	45,0±1,8	65,0±4,1	87,0±3,8	30,0±0,7	32,5±0,93
Gumate Ideal	80,2±4,0	60,4±3,3	47,5±3,54	65,0±1,2	30,5±1,4	45,0±1,74
Gumate Biomaster	79,3±3,2	10,2±0,6	51,5±3,44	55,0±1,8	35,0±1,06	45,0±1,74
Gumate 7+	90,0±4,5	11,4±0,8	60,0±3,21	45,0±1,5	25,5±1,32	25,0±0,33
Control, water	75,4±2,8	75,5±3,8	65,0±4,14	75,0±3,7	22,3±0,99	0

Pre-sowing treatment of watercress seed material with humate solutions did not lead to a significant increase in growth performance; almost all experimental options were worse or at the same level as the control values. Moreover, the effectiveness of commercial preparations turned out to be lower than that of the studied humate produced by Shubarkol Komir. Among the concentrations under consideration, the best result of

germination energy and germination was obtained when seed material was treated with a 0.01% HS solution: 72.5% ± 4.75 and 86.0% ± 5.66, respectively.

Interesting results were obtained when studying the effect of pre-treatment of radish seed material with humates. Firstly, seed treatment with commercial preparations led to a decrease in growth rates compared to control values.

Secondly, radish seeds soaked in Shubarkol Komir humates had a high growth rate; germination energy in almost all experimental variants coincides with germination, which indicates rapid and friendly seed germination. The solution with a concentration of 0.1% had the best efficiency, and germination and germination energy in this case were 100%.

Table 2

The influence of different concentrations of humates on the germination of seed material of the studied species

Experience option	Tomato	Sweet pepper	Watercress	Radish	Eggplant	Chickpeas
GS 0,1%	86,5±4,59	87,7±4,74	59,5±2,78	100,0	54,5±1,5	60,0±2,71
GS 0,5%	100	96,0±4,62	57,0±2,7	20,0±0,14	52,5±2,37	54,2±2,0
GS 0,01 %	80,0±4,14	41,1±0,31	86,0±5,66	60,0±1,14	43,8±0,73	55,6±1,8
GS 0,05%	86,7±4,33	76,2±3,26	76,0±3,08	65,0±3,4	32,3±0,7	57,5±1,53
GS 0,005%	69,3±1,75	60,2±3,61	76,5±2,12	91,0±2,73	49,3±0,7	47,5±1,66
Gumate Ideal	93,3±5,16	75,0±2,37	52,5±1,61	75,0±3,4	41,3±0,44	57,5±2,89
Gumate Biomaster	86,7±3,16	23,8±2,91	59,5±2,51	65,0±1,07	50,5±1,5	52,5±1,86
Gumate 7+	100	16,7±0,86	70,4±4,5	50,0±2,5	37,0±1,6	55,0±1,77
Control, water	87,5±4,13	83,75±5,46	85,0±4,11	80,2±2,8	36,0±1,3	0

The chickpea seed material in the control, without pre-treatment with humates, did not sprout, i.e. we can conclude that this crop requires mandatory pre-sowing preparation. The growth indices of seeds that underwent pre-sowing treatment with the studied humates produced by Shubarkol Komir are similar to the data obtained from seeds treated with comparison preparations. The best option is a solution with a GS concentration of 0.1%, the germination energy was 52.5%±1.66; germination — 60.0%±2.71.

In addition, the ability of humate solutions to suppress the development of phytopathogenic fungi was investigated (Table 3).

Almost all types of seeds were damaged to one degree or another by mold fungi in the control; chickpea seeds experienced the greatest damage; more than 50% of the seed material was damaged.

Table 3

Comparison of the degree of damage by phytopathogens to seed material of various vegetable crops after pre-treatment with humates

Experience option	Tomato	Sweet pepper	Watercress	Radish	Eggplant	Chickpeas
GS 0,1%	-	-	-	-	-	-
GS 0,5%	-	-	-	-	-	-
GS 0,01 %	-	-	-	-	-	-
GS 0,05%	-	-	-	-	-	-
GS 0,005%	+	-	-	-	-	+
Gumate Ideal	+	-	-	-	-	++
Gumate Biomaster	+	-	-	-	-	+
Gumate 7+	-	-	-	-	-	-
Control, water	++	+	+	+	++	++++

Pre-treatment of seed material with humates leads to less damage to the seed material. Using the example of pepper, watercress, radish and eggplant, we can conclude that contact with a solution of humates of any concentration and from any manufacturer leads to inhibition of the development of phytopathogenic fungi on seed material. Using the example of tomato and chickpea seeds, it can be seen that the concentration

of the humate solution used for preliminary treatment matters. The content of humates produced by Shubarkol Komir in the solution should not be less than 0.05%, otherwise the effectiveness of the antifungal effect is significantly reduced.

Conclusion

Despite the differences in the reaction of the seed material of cultivated plants, it can be concluded that pre-treatment with humates produced by Shubarkol Komir leads to an increase in the growth characteristics of the seed material compared to control indicators, and also has pronounced antifungal activity. In addition, the described experimental data demonstrate that the studied humates have an effectiveness comparable to, and in some cases greater than, the effectiveness of widely used commercial preparations of humic substances.

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«Шұбаркөл көмір» АҚ өндіретін гуматтардың әртүрлі көкөніс дақылдарының тұқымдық материалының өнуіне әсері

Гуминдік заттардың биологиялық белсенділігі өсімдіктердің қолайсыз факторларға төзімділігін арттырудан және олардың метаболикалық процестерін ынталандырудан көрінеді, бұл тұқымдық материалдың да, бүкіл өсімдіктің вегетативті бөлігінің де өсу сипаттамаларына оң әсер етеді. Мақалада «Шұбаркөл көмір» АҚ өндірген гуматтарды егіс алдындағы сіңіру кезінде әртүрлі дақылды өсімдіктердің тұқым материалының өнгіштігіне әсері қарастырылып, олардың саңырауқұлаққа қарсы белсенділігі бағаланды. Салыстырмалы препараттар ретінде коммерциялық гуматтар «Идеал», «Гумат 7+» және «Биомастер» гуматтары қолданылды. Тәжірибелерде қызанақ, «Сибирское яблоко» сорты; баклажан; «Икорный Рай» сорты; болгар бұрышы, «Д'Артаньян» сорты; екпе-шиырмақ, мол жапырақты сорт; шалғам, «5+» сорты; -ноқат сияқты дақылдар мен сорттардың тұқымдық материалы пайдаланылды. Қызанақ пен болгар бұрышы үшін тұқымдық материалды сіңіруге арналған ерітіндідегі гуматтың ең жақсы мөлшері 0,5%, ал баклажан, екпе-шиыршық, шалғам және ноқат үшін — 0,1% болды. «Шұбаркөл көмір» АҚ гуматының тиімділігі мен сақырауқұлаққа қарсы белсенділігі эталондық препараттар ретінде қолданылатын коммерциялық препараттардан кем түспейді.

Кілт сөздер: гуматтар, тұқым материалы, алдын ала өңдеу, өну, өну энергиясы, саңырауқұлаққа қарсы белсенділік.

М.К. Смагулов, А.Т. Серикбай, А.Ж. Алимжанова, Д.В. Агеев, А.Ш. Додонова

Влияние гуматов производства АО «Шубарколь комир» на всхожесть семенного материала различных овощных культур

Биологическая активность гуминовых веществ проявляется в повышении устойчивости растений к неблагоприятным факторам и стимуляции их обменных процессов, что положительно сказывается на ростовых характеристиках как семенного материала, так и вегетативной части целого растения. В статье рассмотрено влияние гуматов производства АО «Шубарколь комир» при предпосевном замачивании на всхожесть семенного материала различных культурных растений, проведена оценка их противогрибковой активности. В качестве препаратов сравнения использовали коммерческие гуматы «Идеал», «Гумат 7+», «Биомастер». В экспериментах использовали семенной материал следующих культур и сортов: томат, сорт «Сибирское Яблоко»; баклажан, сорт «Икорный Рай»; перец болгарский, сорт «Д'Артаньян»; кресс–салат, сорт «Обильнолистный»; редис, сорт «5+»; нут. Для томата и перца болгарского лучшим содержанием гуматов в растворе для замачивания семенного материала оказалось 0,5 м %, для баклажана, кресс-салата, редиса и нута — 0,1 %. Эффективность и противогрибковая активность гумата АО «Шубарколь комир» не уступает коммерческим препаратам, использованным в качестве препаратов сравнения.

Ключевые слова: гуматы, семенной материал, предварительная обработка, всхожесть, энергия прорастания, противогрибковая активность.

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