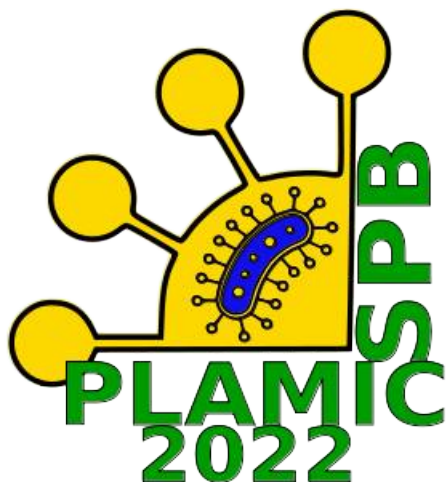


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# НАУКА И УНИВЕРСИТЕТЫ

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**Влияние стрептомицетов, выращенных на молочной сыворотке,  
на ростовые характеристики культурных растений**

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Из огромного разнообразия почвенной микробиоты с практической точки зрения наиболее интересны бактерии, улучшающие плодородие почвы. Численность населения земного шара в ближайшие годы достигнет 8 миллиардов человек и будет неуклонно расти, поэтому продовольственная проблема не утратит своей актуальности. Почвенные бактерии, полезные для человека, вступают в симбиоз с растениями, синтезируют вещества, стимулирующие их рост, оказывают антагонистическое действие на патогенную и условно-патогенную для растений микрофлору. Полезное действие этих бактерий коррелирует с их количеством. Поэтому в сельском хозяйстве наряду с минеральными используют бактериальные удобрения, содержащие микроорганизмы, внесение которых увеличивает количество соответствующих бактерий в почве.

В качестве микроорганизмов для бактериального удобрения мы используем *Streptomyces coelicolor*, которые выращиваем на молочной сыворотке, отходе производства сыра и творога. Выращивая бактерии на молочной сыворотке, мы частично решаем проблему ее утилизации, так как в России сыворотка вырабатывается в большом объеме, до пяти миллионов тонн в год, и является загрязнителем окружающей среды. Выбор стрептомицетов связан с их способностью синтезировать фитогормоны, способствующие росту и развитию растений, а также антибиотики, оказывающие биостатическое действие на конкурентов в почве.

Удобрение проверяли на сельскохозяйственных культурах в лабораторных условиях (выращивание семян в контейнерах с почвой или между слоев бумаги) и в условиях ботанического сада на делянках размером 0,5\*1 м<sup>2</sup>. Изучали влияние удобрения на томаты, люцерну, пшеницу, кресс-салат, редис. Стрептомицеты увеличивают всхожесть семян на 13-16%, длину побегов на 11-13% по сравнению с поливом водой. Необходимо также отметить, что при поливе стрептомицетами увеличивается вегетативная биомасса растений по сравнению с контролем. Среднее количество листьев у капусты через месяц после посева увеличилось на 26,6%, средняя масса листьев салата-латука увеличилась в 1,83 раза. Это позволяет использовать удобрение на стадии выращивания рассады, либо при выращивании зеленных культур. В лабораторных условиях в контейнерах с почвой, политой стрептомицетами, побеги выживали дольше, чем при поливе водой и разбавленной сывороткой. При выращивании между слоями бумаги, пропитанной удобрением, содержащим стрептомицеты, наблюдалось меньше побегов, пораженных плесенью, чем в контроле.

Таким образом, удобрение, полученное путем выращивания стрептомицетов на молочной сыворотке, показало хорошие результаты. В дальнейшем планируется разработать технологию промышленного получения удобрения.

**The effect of streptomycetes grown on whey on the growth characteristics of crop plants**

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Bacteria that improve soil fertility are the most interesting of all the soil microbiota. The world's population will reach 8 billion people in the coming years and will steadily grow, so the food problem remains actual. Soil bacteria, which are useful for humans, are in symbiosis with plants, produce compounds that stimulate their growth and have an antagonistic effect on pathogenic and conditionally pathogenic microflora. The beneficial effect of these bacteria correlates with their number. Therefore, bacterial fertilizers containing microorganisms are used along with mineral fertilizers in agriculture. The application of these fertilizers increases the number of relevant bacteria in the soil.

We use *Streptomyces coelicolor* as microorganisms for bacterial fertilizer, which are growing on whey, that is cheese and cottage cheese production waste. In Russia, whey is produced in large volumes, up to five million tons per annum, and is an environmental pollutant. We partially solve the problem of whey utilization, as we grow bacteria on it. The choice of *Streptomyces* is connected with their ability to synthesize phytohormones that promote plant growth, as well as antibiotics that have a biostatic effect on competitive bacteria in the soil. The effect of fertilizer on the growth of agricultural crops was tested in laboratory conditions (growing seeds in containers with soil or between layers of paper) and in open ground plots of 0.5 × 1 m<sup>2</sup>. We studied the effect of fertilizers on tomatoes, alfalfa, wheat, watercress, radishes. Streptomycetes increase seed germination by 13-16 % and shoot length by 11-13 % compared to watering with water. When watering with streptomycetes, the vegetative biomass of plants increases compared to the control. The average number of cabbage leaves increased by 26.6 % a month after sowing, the average weight of lettuce leaves increased by 1.83 times. All shoots survived longer when watered with streptomycetes than when watered with water. When we grew seeds between layers of paper soaked with a fertilizer containing streptomycetes, there were fewer shoots infected with mold than in the control. Thus, the fertilizer obtained by growing streptomycetes on whey showed good results. In the future, it is planned to develop a technology for the industrial production of fertilizers.