Growing methods that promote the production of early potato products of the Udacha variety

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Abstract: The scientific article presents the results of five-year research on an effective method of growing potatoes of the early variety Udacha, for obtaining products in the second decade of July in the conditions of the Moscow region of the Russian Federation. For the formation of the potato yield, various methods were used to optimize the conditions for the growth and development of plants in the early spring and summer periods, for the experiments used (pre-planting glauconite sands 10, 20 and 30 g/plant, the effect of drip irrigation on the formation of early production the use of a covering material during germination of potato tubers, light germination of tubers). In the studies, observations were made of the early ripening potatoes of the Luck variety. Our research is aimed at increasing early potato yield through environmentally friendly practices. Thus, according to the results of the study, the following data were obtained: the interphase period of seedling-harvesting had a difference of 5 ... 7 days, depending on the variant of the experiment, this period was 46 ... 56 days, which corresponds to the length of the growing season for early-maturing varieties grown under optimal conditions. The average mass of tubers per plant for all variants as of July 15 was 787.1 grams, which is not a bad indicator for the Moscow region. The maximum early yield was achieved in the variants with the use of drip irrigation with the introduction of glauconite sands at a dose of 20 and 30 g/plant and in the variant with light germination in combination with a covering material of 17 g/m².

1. Introduction

Getting early production of potatoes, in the Moscow region, poses many tasks for the agronomist, first of all, the choice of a variety and the necessary energy-saving and environmentally friendly agricultural technology, which contributes to an increase in early production [1-2]. Early potatoes are important in human nutrition and remain in demand, which is confirmed by data on gross production in our country. Russia ranks third in potato cultivation after China and India [2-4]. The increase in gross production is due to the introduction of modern high-yielding varieties, new technologies, the use of organic and mineral fertilizers, as well as protective measures aimed at increasing the yield and product quality [5-7]. Due to its nutritional value, versatility of use, it has a high taste, which makes it included in the children's diet. Potato tubers are used not only in human nutrition, but are also a valuable product with a high digestibility of 85-95%. Used fresh and processed.
2. Problem statement
In the farms of the Moscow Region, growing early potatoes remains profitable, since prices in the summer are much higher than those of late-ripening varieties in the autumn-winter period. Scientific research in different regions of our country proves that most of the technological methods ensure high yields in the early stages, but the choice remains with the specialist and its correct application, depending on the climatic zone.

3. Research questions
The studies examined the effect of drip irrigation, the combined use of drip irrigation during the growing season and the introduction of glauconite sand in different doses, germination of tubers separately and in combination with a covering translucent nonwoven material 17 g/m².

4. Purpose of the study
Objective of the studies: to study the effect of growing conditions on potato productivity in the second decade of July.

5. Research methods
The research was carried out at the Timiryazev Russian State Agricultural University-Moscow Agricultural Academy. The research period is 2016-2020 [8]. The planting of tubers and the care of plants were carried out in accordance with the biological characteristics of the culture. Planting for all years was carried out in the first decade of May, at a soil temperature of 6…8 °C, a layout scheme of 70x35 cm, an accounting plot area of 25 m². For planting, tubers of the middle fraction of the Luck variety were used, without preliminary preparation, depending on the variant of the experiment: 1) control (tubers of the middle fraction, without germination), 2) planting of tubers of the middle fraction without germination + drip irrigation, 3) tubers of the middle fraction + drip irrigation + glauconite 20 g/m², 4) tubers of the middle fraction + drip irrigation + glauconite 30 g/m², 5) tubers of the middle fraction + drip irrigation + glauconite 40 g/m², 6) tubers of the middle fraction germinated in the light, 7) tubers of the middle fraction germinated in the light + covering translucent material 17 g/m². For the care of the plants, weeding, hilling and preventive treatment against Phytophthora infestans were carried out. Variety Luck is a table purpose, possibly used for processing. The tubers are light beige, the flesh is white, the mass of the marketable tuber is 120…150g, the marketability is 96…100%, the average yield is 30…50 t/ha. Resistant to viral diseases, Phytophthora infestans of leaves and tubers, black leg, common scab, Rhizoctonia. During the period of cleaning and transportation, it is resistant to mechanical damage.

6. Findings
Early potatoes are grown mainly for fresh consumption; they are in demand both for buyers in the retail network and for fresh cooking in cafes and restaurants [9]. Potatoes are moisture-loving crops, the need for which varies depending on the phase of plant development [10-13]. If we analyze the average annual precipitation for the period of research, then it is within sufficient limits for potatoes and averages 771.8 mm. However, if we compare the moisture supply by months, then in recent years the amount increases in May, and in June, during the beginning of flowering, it decreases, which may lead to a decrease in yield. In the conditions of the Moscow region in the summer, an increase in precipitation is noted in the second half of summer, which contributes to the development of potato diseases in the second half of the growing season. Our task is to get potato products as early as possible. In the experiment, we took as a basis options with drip irrigation and a covering material, which helps to warm the soil in the early spring period and prevents the evaporation of moisture from the soil. Covering was carried out during the germination of tubers; after the emergence of seedlings and a stable favorable temperature, the material was harvested; therefore, the plants in the phase of flowering and tuberization were on a natural background in relation to the variants with drip irrigation. During the research period, a decrease in yield was assumed in the following options: 1) control (medium fraction tubers, without germination), 6)
medium fraction tubers germinated in the light, 7) medium fraction tubers, germinated in the light + covering translucent material 17 g/m², due to uneven water supply to plants, which can lead to a natural decrease in the average mass of tubers. At the same time, in options: 6) tubers of the middle fraction germinated in the light, 7) tubers of the middle fraction germinated in the light + covering translucent material 17 g/m², it was possible to get early production of potatoes, due to before planting germination and more favorable growing conditions in the initial period. The experiment was carried out on sod-podzolic soils, where a lack of trace elements is possible, in this regard, different doses of glauconite sand were included in the options with drip irrigation - this is a mineral used as a sorbent, as well as in the form of a mineral potassium fertilizer (contains 8 trace elements), such as boron, phosphorus, potassium, iodine, silver, molybdenum, etc. The easy availability of trace elements is important. The technology using glauconite sand and drip irrigation is quite promising and environmentally friendly for open ground conditions. Glauconite is a natural mineral from the group of greenish hydromicas, its use began and was described since 1828 by a German scientist mineralogist. The chemical composition contains potassium, sodium, aluminum, iron, magnesium, silicon, water in an easily accessible form for plants. The phase of emergence of seedlings by years, on average, was noted on 17...22 days from the date of planting, the use of pre-planting germination of tubers contributed to the earlier emergence of seedlings, on average by 5...6 days, in variants with drip irrigation and glauconite sand contributed to the emergence of seedlings by 1...3 days in relation to the control option. Light germination of tubers and drip irrigation in combination with glauconite sands increased the proportion of shoots (+ 3-4 pcs) per plant. The budding period for all variants began on 16 ... 20 days, after 7...12 days the plants entered the flowering phase. Since the goal was to get products early (on July 15), the full cultivation cycle was not carried out; at the time of harvesting the tubers, the plants of all variants passed the flowering phase, but there were no signs of leaf withering away. In variants with the use of drip irrigation and glauconite sands, an attractive appearance was noted, due to the greater number of shoots and a large leaf blade.

The main indicator of the study is yield, its result depends on many factors [13-14]. First, the sprouting-harvesting interphase period had a difference of 5...7 days, depending on the variant of the experiment, this period was 46 ... 56 days, which corresponds to the length of the growing season for early maturing varieties grown under optimal conditions. Secondly, in variants 2, 3, 4, and 5, the plants were provided with drip irrigation, which provides soil moisture at the level of 60 ... 80% of the maximum field moisture capacity. Thanks to the provision of small-drop irrigation, the crop was able to form at an early date, since according to some scientists, the average daily growth of tubers with irrigation can be on average 30...35 grams, during the period of tuberization (in the Moscow region, this period for early maturing varieties falls on June). Light germination, separately and together with the covering material, also contributed to an increase in the growing season due to earlier emergence of seedlings. Early yields in all years were counted on the same date, July 15th. Figures 1 and 2 show that using optimization methods, when growing and receiving early production, provided an increase in the average mass of tubers from one plant and, accordingly, the total yield. According to the research results, the average mass of tubers per plant for all variants was 787.1 grams, which is a good indicator for the Moscow region. The maximum mass of tubers from one plant was noted in the following variants: 3) tubers of the middle fraction + drip irrigation + glauconite 20 g/m², 4) tubers of the middle fraction + drip irrigation + glauconite 30 g/m², the weight gain to the control was 384.2 and 484.2 g/ plant, respectively. The minimum increase in the average weight of one plant was noted in option No 6) medium fraction tubers germinated in the light, the difference with the control variant was 46.2 g/ plant. The rest of the variants had an average value in relation to the control.
Figure 1. Average mass of tubers per plant (as of July 15) potato cultivars Luck, depending on the variant of the experiment, (average data 2016 ... 2020).

Figure 2. Yield of early production (as of July 15) potato varieties Luck, depending on the variant of the experiment, (average data 2016 ... 2020).

The early yield in the options for drip irrigation in combination with glauconite sand was quite high in all years, in options No 4) and No 3), the increase in yield was 76 and 66% in relation to the control, and an increase of 38% occurred in option No 7) with the use of light germination with covering material. On average, the increase ranged from 6 .. 17% in options No 2) planting medium fraction tubers without germination + drip irrigation, No 5) medium fraction tubers + drip irrigation + glauconite 40 g/m², No 6) medium fraction tubers germinated in the light, in relation to the control variant.
7. Conclusion
Thus, the use of drip irrigation in combination with glauconite sand 20 and 30 g/plant, gives the maximum increase in yield. In hot years, watering has a limiting factor, however, in combination with glauconite sand, the effect increases. Comparing separately the option with drip irrigation in relation to the control, the increase was 30% and in relation to the light germination option, the difference was 4.7 tons/ha, with an increase in relation to option No 2. This proves that the presence of moisture affects the formation of the crop, especially in hot years.

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Conflict of interest
The authors have no conflict of interest to declare.

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