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Cultivation of Egg Plant (*Solanum melongena* L.) Using Drip Irrigation with The Use of Mineral Fertilizers in the Conditions of The South-east Kazakhstan

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Kazakhstan has the largest land resources with the total area of 272 million ha. Out of the total land area of the Republic, its main part consists of agricultural land, and includes 222.6 million ha (over 80%). However, agriculture in Kazakhstan exists in extremely harsh climatic conditions, where the annual rainfall in the main producing areas is 200-300 mm. Currently, Kazakhstan starts experiencing shortage of water resources, and according to forecasts, it may face significant water shortage by 2040. In order to save irrigation water and increase crop yield, water-saving irrigation methods are to be developed and tested. One of the ways to achieve these goals is the introduction of modern irrigation methods, drip irrigation in particular. For Kazakhstan, drip irrigation is a relatively new technology. Therefore, in 2013-2014 we studied eggplant cultivation with the use of drip irrigation with various doses of fertilizers. The aim of this work was to study the influence of drip irrigation with the use of fertilizers on economy of irrigation water and yield of cultivated eggplant in the conditions of the South-East Kazakhstan. The study was performed in accordance with generally accepted and available techniques. Eggplants were planted in a 70x30 cm pattern, plant population was 47.6 thousand plants/ha. The following was used for the study: furrow irrigation (control), drip irrigation system. To determine the effect of fertilizers together with drip irrigation, 4 norms of fertilizers were taken: $N_0P_0K_0$ (control), $N_{50}P_{30}K_{40}$, $N_{100}P_{60}K_{80}$ and $N_{150}P_{90}K_{120}$. The studies proved that the use of drip irrigation system for growing eggplant ensures saving of irrigation water by 29.27%, while infestation of crops decreased by 58.46%. When the triple rate of fertilizer ($N_{150}P_{90}K_{120}$) was used, yield increased by 41.37%, as compared to the reference ($N_0P_0K_0$).

Key words: Eggplant, drip irrigation, furrow irrigation, Saving irrigation water, fertigation, weeds, productivity.

Rational use of soil and water resources is one of the most important tasks of ameliorative science and practice of irrigated agriculture. Severe shortage of water resources and adverse soil conditions require development of water-saving differentiated irrigation regimes, the use of which will contribute to improvement of ameliorative conditions in the irrigated land (Akhmedov, A. D. and Davidov, I.A., 2009). Currently, Kazakhstan, as a part of the world, starts experiencing water

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shortage, and according to forecasts it may face significant water shortage by 2040 in the amount of 50% of the demand. The total water supply intake in 2012 amounted to 19.5 km^3, and agriculture accounts for the major part of the water consumption, 68%. In early 90s, the irrigated land actually occupied over 2.1 million hectares and ensured production of over 30% of the gross product of the crop sector. Currently, according to the statistic data, the area of irrigated land in the country is less than 1.5 million hectares, which provides only 5.3% of the gross crop production, i.e., not only the area of irrigated land decreased, but its productivity, as well. The use of water saving technologies for water supply and irrigation (drip, sprinkler, discrete) in agriculture is less than 7% of the used irrigated land, or 95.8 thousand hectares (the State Program of Water Resources Management in Kazakhstan, 2014). Currently in Kazakhstan water conservation technologies are introduced in the area of 18.3 thousand ha, which is less than 2% of the total irrigated land. Meanwhile, only potatoes and the vegetable and melon crops in the Republic occupy 340-360 thousand ha. This means that there is great potential for introduction of water saving technologies (Aitbaeva A. T. and Buribaeva L.A., 2012). The issue of increasing productivity in agriculture and crop production is particularly urgent. One of the ways to achieve these goals is the introduction of modern irrigation methods, drip irrigation in particular. The Head of State has set the task to introduce modern irrigation methods in 15% of seedlings in agriculture. Vegetable farms are interested in drip irrigation. All in all, the state predicts financing of about 10 thousand hectares by 2020 (Zhakeyev M., 2014).

The traditional surface irrigation systems gradually give way to semi-stationary and stationary systems, which are used not only for irrigation but also for introducing fertilizers and preparations of protecting plants from diseases and pests, and fighting frost. Aeration irrigation, etc. Analysis of literature shows that with the use of surface irrigation, old-irrigated soils are washed out during the first irrigation by 50 t/ha, and new-irrigated soils are washed out by 100-179 t/ha of soil. The results of erosion reduce efficiency of mineral fertilizers, as well as humus content. Within many years of using ridge-and-furrow irrigation, soil fertility gradually reduced. Agrophysical and agrochemical soil properties worsen, and crops yield gradually decreases. In order to save irrigation water and increase soil fertility and crop yield, water-saving irrigation methods are to be developed and tested. Developed countries use water-saving methods of irrigation, such as the sprinkling, drip irrigation and subsurface irrigation, and save 40 – 50 % of irrigation water. They increase crop productivity and soil fertility (Ilkhamov N. M., 2013).

Drip irrigation is an economically viable and environmentally safe method of irrigation, where water is supplied in small portions to the roots of plants from above-ground piping through slit-like openings in the irrigation bands (tapes) that are laid in the earth or on its surface. The essence of automatic drip watering (irrigation) is that the plant is watered instead of earth. This effect is achieved due to the ingress of water directly to the rhizosphere through elastic tubes (tapes) that have slit-like openings (drippers) along their entire length.

The main priority of drip irrigation, as compared to other irrigation methods, is significant saving of irrigation water (about 50 – 90 %) (Laptaev V. N., 2006). Also, drip irrigation insures constant moistening of the rhizosphere, while soil surface remains dry, which greatly reduces water loss through evaporation and does not hinder soil and plants care. Weeds and unwanted organisms develop poorly in such conditions (Khrabrov M, 2008).

For the Republic of Kazakhstan, drip irrigation is a relatively new technology. In 2005, only 160 hectares in the country were irrigated using the drip method. In 2009, the drip irrigated area reached 4,206 ha, and in 2010 – 10,788 ha. In 2011, water saving technologies were introduced in the area of 18,311 ha. That is, the increase was more than 100 times.

In order to expand drip-irrigated areas sown with agricultural crops in our country, it is necessary to fully explore this technology and to develop scientifically grounded recommendations that would ensure high agro-economic and ecological efficiency (Mirzakeyev E. K., et al., 2010).

According to the Ministry of Agriculture of the Republic, the area for less common crops, including about 3.5 thousand hectares for eggplants, is being expanded, of which one third is located in the South-East of the Republic. In Kazakhstan, and in the area of the foothill zone of the South-Eastern Kazakhstan in particular, eggplant is an insufficiently studied vegetable crop. Despite this, an urgent task is the development of new technologies and improvement of existing elements of the technology of its cultivation, and selection of new species and hybrids in open ground during drip irrigation. In this regard, eggplant cultivation has several completely unresolved issues about the influence of irrigation methods and the use of fertilizers in a specific soil-climatic zone. It is not quite clear, which of these factors influence harvest formation the most. In case of drip irrigation, elements of eggplant cultivation technology become particularly important.

METHODS

Research location

The research work was performed at pilot stations of LLP “The Kazakh Research Institute of Potato and Vegetables Growing” located in the submontane zone of the South-Eastern Kazakhstan, on the Northern slope of the ZailiyskAlatau at the altitude of 1,000-1,050 m above the sea level.

The soil at the experimental plots is dark brown, medium loamy, with fully developed profile, clearly differentiated by genetic horizons. The arable layer of soil contains 2.9 – 3.0% of humus; 0.18 – 0.20% of total nitrogen; and 0.19 – 0.20% of total phosphorus. Mobile phosphorus content in the topsoil is 30-40 mg per 1 kg of soil, exchange potassium – 350-390 mg per 1 kg of soil. The amount of absorbed bases is 20-21 mg-eq per 100 g of soil (Table 1).

Reaction of soil solution is slightly alkaline (pH 7.3 to 7.4). Soil bulk density is 1.1 to 1.2 kg/cm^3, and the lowest moisture retaining capacity is 26.6 %. Soil structure is loose and mild. It swells after irrigation and rain, forming a dense crust that violates its water and air regime.

The climate is sharply continental. The average temperature in July is 22-24º! above zero, January 6-10 º! below zero. The temperature constantly goes through 0 °C in the spring in late II or early III decade of March, and in the autumn – in late I – early III decade of November. The sum of positive temperatures is 3450-3750°C, and the sum of temperatures for the period with temperature above 10°C ranges between 3100 and 3400°C. Spring frosts stop in the III decade of April, autumn frosts resume in the III decade of September – early October. The average frost-free period is 140 to 170 days. Annual precipitation is 350 to 600 mm. During the warm period, precipitation is 120 to 300 mm. Stable snow cover is formed in the end of November – beginning of December and is maintained for 85 to 100 days. Depth of snow reaches 20-35 cm.

Research procedure

The research was performed in accordance with the following procedures, guidelines, instructions: Methods of Field Experiments (Dospehov B. I., 1985); Methods of Experimental Work in Vegetable and Melon Farming (Byelik B. F., 1992); Recommendations for Field work in the Spring in the South-Eastern Kazakhstan (Recommendations for Field work in the Spring in the South-Eastern Kazakhstan, 2008); Recommendations for Crops Cultivation in case of drip irrigation (Recommendations for Crops Cultivation in case of drip irrigation, 2003); the Procedure for Agrochemical research (F. Yudin, A., 1980).

In the research, the Almaz breed was used, which is adopted for use in the Republic of Kazakhstan (The State Register of Achievements in Breeding Approved for Use in the Republic of Kazakhstan, 2012). The following was used for the research: furrow irrigation (reference), drip irrigation system (Naan Dan Jain, Israel). Length of irrigation furrows is 100 m, the inter-row spacing is 0.7 m, the layout (method) of planting (seeding) is 70x30 cm, plant population is 47.6 thousand plants/ha. The pressure in the main pipe is 0.8-1.0 atm., working pressure in the drip tapes is 0.3 to 0.4 atm., the number of drippers is 47,614 units/ha.

The norms of vegetative irrigation are defined by moisture deficiency in soil between the upper limit of humidity (the lowest moisture retaining capacity) and its lower limit according to the formula of I. A. Kostyakov. The irrigation water was accounted for with the help of an uncovered Cipolletti weir with the threshold of 50 cm, installed in the beginning of the experimental plot and in the end of the plot, for accounting for the return water.

In order to establish the time of next irrigation, soil moisture was determined periodically (every 7 days) using the sensor-weight method.

For determining the effect of fertilizers together with drip irrigation, 4 norms of fertilizers were taken: $N_0P_0K_0$ (control), single – $N_{50}P_{30}K_{40}$, double – $N_{100}P_{60}K_{80}$ and triple – $N_{150}P_{90}K_{120}$.

RESULTS

With the use of a measuring flask and a stopwatch, water supply from 1 dripper (l) was calculated for certain periods (20 and 30 minutes, 1, 1.5, and 2.0 hours). It was experimentally found that after 1 hour of irrigation, soil (dark brown) receives 1.5 liters of water (fluctuations up to 2%). (Table 2).

Table 1. Main agrochemical parameters of experimental plot soil (dark brown)

Depth, cm	Humus, %	Gross forms, %			Mobile forms, mg/kg		pH (saline)	Total particles, <0.01 mm %
		Nitrogen	Phosphorus	Potassium	Phosphorus	Potassium		
0-20	3.03	0.20	0.20	2.3	33	360	7.3	39
20-30	2.90	018	0.20	2.4	24	350	7.3	41
30-45	1.80	0.14	0.18	2.2	17	330	7.4	44
45-60	1.40	0.10	0.16	1.9	-	-	-	-

Table 2. Water supply through drip tapes during a period, liters (2013-2014)

Measurements of irrigation water	Water supply from 1 dripper to roots of plants for an accounting period (liters)			
	20 minutes	30 minutes	1 hour	2 hours
1	0.502	0.753	1.506	3.012
2	0.504	0.756	1.512	3.024
3	0.498	0.747	1.494	2.988
4	0.498	0.747	1.494	2.988
5	0.498	0.747	1.494	2.988
6	0.494	0.741	1.482	2.964

For optimal supplying water to plants, soil moisture content is important. We measured soil wetting on the surface and at depth (Table 3).

Table 3. Soil surface and depth wetting in case of drip irrigation (2013-2014)

No. of measurements	Water supply, ml		Soil surface wetting, cm		Wetting at depth after 2 hours, cm
	After 1 hour	After 2 hours	after 1 hour	after 2 hours	
1	1.506	3.012	21.6	30.6	28.1
2	1.512	3.024	21.9	30.5	27.5
3	1.494	2.988	20.4	29.1	27.1
4	1.494	2.988	21.3	30.0	27.1
5	1.494	2.988	21.2	29.6	26.9
6	1.482	2.964	20.4	28.4	26.5

Eggplant drip irrigation regime, developed and recommended by us for the soil and climate conditions of the foothill zone of the South-Eastern Kazakhstan is shown in Table 4.

In our research, water consumption by eggplants significantly differed, depending on weather conditions of the vegetation period of 2 years. In 2014, cost of irrigation water for formation

Table 4. Irrigation regime for solanaceous vegetable crops in case of drip irrigation technology (2013-2014)

Parameters	Values
Density of plant standing per 1 ha, thousand plants	47.6
Pressure in main pipes, atmospheres	0.8-1
Working pressure in drip tapes, atmospheres	0.3-0.4
Number of drippers per 1 ha, pcs.	47,614
Water consumption per 1 dripper, l/h (average)	1.5
Irrigation time per day, hours (by development phenological stage)	1.5-3.5
Water supply per 1 ha per one irrigation, m^3 (average)	127.30
Water consumption per 1 plant per one irrigation, l (average)	2.674
Number of irrigations during the vegetation season, times	26
Consumption of irrigation water during the vegetation period, m^3/ha	3,310

Table 5. Expenses (savings) for irrigation water in case of eggplant drip irrigation during the vegetation period, m^3/ha (2013-2014)

Solanaceous vegetables irrigation technology	Saving of irrigation water
Furrow irrigation (traditional), m^3/ha	4,680
Drip irrigation (under experiment), m^3/ ha	3,310
Saving of irrigation water per season m^3/ ha	1,370
%	29.27

Table 6. Weedinessof eggplants depending on the irrigation technology (2013-2014)

Irrigation technology	Number of weeds
1.Furrow irrigation, plants/m^2	65
2.Drip irrigation, plants/m^2	27
Reducing the amount of weeds plants/m^2	38
%	58.46

Table 7. Influence of mineral fertilizers in drip irrigation on eggplant yield (2013-2014)

Experiment variants	Fruit yield, t/ha	Additional yield t/ha	Additional yield %
Reference	24.9	-	-
$N_{50}P_{30}K_{40}$	28.6	3.7	14.86
$N_{100}P_{60}K_{80}$	32.7	7.8	31.33
$N_{150}P_{90}K_{120}$	35.2	10.3	41.37

of eggplant plants biomass and fruit yield was much higher, compared to 2013, due to unfavorable weather conditions in this year. Accordingly, water saving was lower. However, in experiments with eggplants, a significant reduction of irrigation water expenses was noted, compared to the traditional furrow irrigation method (Table 5).

Phytosanitary monitoring was performed for determining the number of weed plants among eggplants (Table 6).

The use of various doses of fertilizer with drip irrigation system increased eggplant yield. When the triple rate of fertilizer ($N_{150}P_{90}K_{120}$) was used, additional yield of 10.3 tons/ha was obtained, as compared to the reference ($N_0P_0K_0$).

DISCUSSION

Eggplant drip irrigation

Special measurements with the use of a measuring flask and a stopwatch showed that in 20 minutes 1 dripper releases (supplies) on average 0.5 liters (494 to 504 ml) of water, in 30 minutes – 0.75 l (741 to 756 ml), in 1 hour – 1.5 l (1,482 to 1,512 ml), in 2 hours – 3 liters (2,964 to 3,024 ml) (Table 2).

The results showed that depending on the type of irrigation, the irrigation regime varies significantly. Based on the results of our research a conclusion was made that in medium and dark chestnut soils of the submontane area of the South-Eastern Kazakhstan, a differentiated approach is required for use of drip irrigation. According to average calculation data, within 1 hour of irrigation one dripper on the tape moistens the soil surface 20.4 to 21.9 cm wide, and within 2 hours – 28.4 to 30.6 cm (in diameter). This means that the soil around the plant bush is completely wetted. Infiltration of irrigation water downwards after 1 hour of irrigation was 16-18 cm on the average, and after 2 – 26.5-28.1 cm (Table 3).

Here the arable (root zone) soil layer is completely wetted. Therefore, in early phenological stages, when plants' need in water is low, it is enough to irrigate for 1-1.5 hours. In later periods of plant development, duration of irrigation should be increased to 2 – 2.5, and 2.5 – 3.5 hours, which ensures supply of 3 – 3.5 l, 4 – 5 l of water from one dripper. Such irrigation regime can significantly reduce the expenses for irrigation water and electric power.

The number of irrigations in case of eggplant drip irrigation significantly varied with years of research. So, in 2014 more irrigations were made, compared to 2013, which can be explained by high daytime temperatures and excessive aridness. During eggplant vegetation season, within years 2013 – 2014, 26 irrigations were made on the average (Table 4).

It should be noted that the number of irrigations (26) in case of drip irrigation is acceptable for eggplant only in the conditions of dark chestnut soils of the submontane zone of the South-East, where there's high enough rainfall with relatively high humidity, in comparison to the light-brown and gray soils of this region.

In the submontane zone of dark-chestnut soils with medium loam (close to heavy-loam) mechanical structure that allows it to retain soil moisture and with enough rainfall, especially in the spring during planting and engraftment (rooting) of the seedlings, there is a possibility to reduce the number of irrigation and irrigation norms. Main eggplant irrigations start from mid-June and continue until mid-August, i.e., for about 2 months with intervals of 3 to 4 days, depending on soil moisture. Last irrigations are made with moderate norms with 5 to 7 days intervals in late August – early September. In case of a dry autumn (September), additional irrigations are made. Dripping equipment (pipes and tapes) in the fields with solanaceous vegetable crops should be dismantled after mass harvesting in the end of September.

In the irrigation mode described above, the duration of eggplant intensive irrigation period is about 2 – 2.5 months. This reduces the number of the vegetation irrigations, which, in turn, will ensure substantial saving of water resources and a significant reduction of power expenses for operation of a pumping station (for supplying water).

In our research, irrigation norm for the eggplant, i.e., the total amount of water consumed by plants during the entire growing period from transplanting till massive fruit ripening), during the years of research (2013-2014), on the average was equal to – 3,310 m^3/ha. As research results show, drip irrigation, compared to furrow irrigation (control) resulted in saving irrigation water for eggplant on the average for two years (2013 – 2014) of 1,370 m^3/ha, which amounts to 29.27%. For furrow irrigation, as well as for drip irrigation, water consumption was more significant. So, if for eggplant per 1 ha, 4,680 m^3 of irrigation water was used (Table 5).

Similar experiments were made in countries of the South-Eastern Asia (M. Palada et al., 2011). As a result, in Cambodia, drip irrigation resulted in saving water (by 43%), increased yield (by 15%) and productivity (by 38%) for cucumbers and eggplants. The authors explained such efficiency by the fact that in case of drip irrigation, 90 to 98% of supplied water gets to the roots of the plants. The results of our experiment also show that drip irrigation reduces consumption of irrigation water and is very promising for the conditions of the South-Eastern Kazakhstan.

Phytosanitary state of vegetable crops is important in vegetable production. During transplanting and rooting, eggplant fields are often watered, followed by 10 to 15 days until complete engraftment, and further growth and development. Within this period, the weeds intensively develop, strongly competing with cultivated plants. Weeds shade the plants, rapidly absorb soil nutrients and moisture, thereby reducing the yield from mineral fertilizers and irrigation water. Recently in the South of the Republic, significant losses of vegetables were noted, caused by a complex of pests and diseases. This leads to uncontrolled use of pesticides. As a result, resistant populations of the dominant pests and pathogens are formed. In this regard, norms, multiplicity of chemical treatments, consumption of pesticides increase, environment and vegetable products are polluted (Iskakov, N. S. and Aitbaev T.E, 2011).

One of main advantages of drip irrigation system is decreasing infestation (Voyevodina L. A., 2012). Drip irrigation insures constant moistening of the rhizosphere, while soil surface remains dry, which greatly reduces water loss through evaporation, and does not hinder soil and plants care. Weed vegetation in these conditions is poor. Reducing the number of weed plants ensures minimization of pesticide load on fields, and makes it possible to save the germicidesthat are so expensive today, which increases productivity and sustainability of obtained products. Therefore, phytosanitary state of eggplant crops was assessed.

Phytosanitary monitoring showed that experimental eggplant plots infestation in case of drip irrigation is much lower, compared to furrow irrigation. This is explained by the fact that in case of drip irrigation, a limited soil area is wetted (around the plant bush), and the inter-rows space remains dry. Consequently, fewer weed seeds germinate. It should also be noted that in case of drip irrigation, fields are not infested with weed seeds brought with irrigation water, which is the case with furrow irrigation.

In our studies, reducing the number of weeds in crops of eggplant averaged to 58.46%. Since in case of furrow irrigation, the number of weeds was 65 plants/m^2, in case of drip irrigation, this indicator was reduced by 8 plants/m^2 and was only 27 plants/m^2 (Table 6). It should also be noted that seeds of some species of weeds can survive for many years, and seeds of weeds spread by various means, including wind, etc. (Auezov A., et al. 2005). In case of systematical drip irrigation, this figure can also be reduced.

In the Philippines, drip irrigation increased the average yield of vegetables by 35%. Similar results were obtained in Indonesia. In Vietnam, drip irrigation increased average vegetables yield by 8-11%, and the manpower effort was reduced by 33% (M. Palada et al., 2011).

In our research the average yield of eggplants under drip irrigation increased by 24,19%, compared to furrow irrigation (Rakhymzhanov B. S., et al., 2012).

Eggplants drip irrigation with the use of fertilizers

Agriculture in Kazakhstan exists in extremely harsh climatic conditions, where the annual rainfall in the main producing areas is 200-300 mm, and with deficiency of necessary elements of mineral nutrition for plants: mainly phosphorus, nitrogen and potassium to a lesser degree. Meanwhile, delivery of mineral fertilizers in the country decreased during the years of perestroika from 1.1 million tons (1986) to 36 thousand tons (1995). Use of organic fertilizers drastically decreased (from 33 million tons (1986) to 1,141 thousand tons (1995). Reduction of agrochemical resources supply in agriculture, in turn, led to a sharp decrease in the content of mobile forms of nitrogen, phosphorus and potassium, to reduction of crop yield, and ultimately, of gross crop production. Particularly strained situation is observed in the irrigated area of the Southern and the South-Eastern Kazakhstan, where previously created levels of soil fertility with intensive use of fertilizers have now sharply decreased to their initial state (Eleshev R. E. and Kurishbaev A.K., 2013).

In order to obtain stable yields, it is necessary to meet the needs of the plants in water and nutrients in available form for the whole duration of the vegetation period. Yield formation depends on soil wetting conditions, and the level of mineral nutrition. Improving conditions of wetting with increased soil nutrient status will make it possible to obtain the highest eggplant yield (Akhmedov, A. D. and Davidov, I.A., 2010)

In our field experiments with eggplant, we studied effectiveness of drip technology and of various norms of mineral fertilizers in the drip irrigation system (Table 7). The results of our research showed that the greatest eggplant yield with the drip irrigation was obtained at the norm of $N_{150}P_{90}K_{120}$, compared to other variants. High return from mineral fertilizers is expected. Additional eggplant harvest from increasing fertilization norms (single – $N_{50}P_{30}K_{40}$; double – $N_{100}P_{60}K_{80}$ and triple – $N_{150}P_{90}K_{120}$), was 41,37%; 31,33 and 14,86% of eggplants, respectively (Table 7).

CONCLUSIONS

As a result of the research of eggplant (*Solanum melongena* L.) cultivation with the use of drip irrigation with mineral fertilizers, the following conclusions can be drawn:

The drip irrigation technology, compared to furrow irrigation, resulted in saving of irrigation water by 29.27% on the average. Use of drip irrigation contributed to improvement of eggplant crops and reduced the number of weeds by 58.46%. Also an increase of eggplant yield by 24.2% was observed in case of drip irrigation. The use of various norms of fertilizers together with drip irrigation system led to an additional eggplant yield increase by 14.8 – 41.3% as compared to the reference norm. Thus, drip irrigation is a promising and efficient method of irrigation for eggplants in the conditions of the South-Eastern Kazakhstan.

Our research was performed using available tools and techniques, therefore, it should be noted that this work should continue using various methods, types of fertilizers, especially with various types of micro – and bio-fertilizers, pesticides, with new and promising varieties and hybrids of eggplant. It is necessary to study the effect of drip irrigation on agrochemical and agrophysical, water-physical properties, to determine contamination of dark-chestnut soils located in the foothill zone of South-Eastern Kazakhstan with heavy metals and pesticides. Also, a detailed biochemical analysis of eggplant fruits should be performed, since we did not have the possibility to determine such factors as trace elements, heavy metals, etc.

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