

Topinambour (*Helianthus tuberosus* L.) – of multi-purpose culture and innovative value

Abstract

In the article are resulted the necessary information on a role topinambour (earth pear - *Helianthus tuberosus* L.) in the future in energy and food security of Tajikistan. By authors are described and make important scientific and practical recommendations to farmers and fans about stories of occurrence of this plant, its morphological characteristics, development major factors for grooving of topinambour, requirement of this plant to mineral and organic fertilizers, and also ways of reception of a high yield of topinambour, processing and uses of production of topinambour, as an ecological pure resource for reception of energy, the foodstuffs, a forage for animals and for healthy of people.

Keywords: topinambour, morphology, sunflower, breeding, food security, Tajikistan

Volume 6 Issue 6 - 2021

Kurbonali Partoev

Head of plant genetics and breeding laboratory, Institute botany, plant physiology and genetics, of the National Academy Science of Tajikistan, Director of NGO "Cooperation for development, Tajikistan

Correspondence: Kurbonali Partoev, Dr. of agriculture, Ph.D. of agriculture, Head of plant genetics and breeding laboratory, Institute botany, plant physiology and genetics, of the National Academy Science of Tajikistan, Director of NGO "Cooperation for development, Tajikistan, Tel (+992)918649505, Email pkurbonali@mail.ru

Received: July 10, 2021 | **Published:** December 21, 2021

History of origin topinambour

Topinambour, is more correct - sunflower tuberiferous (*Helianthus tuberosus* L.) - family *Astrovye* perennial plant (*Asteraceae*). Along with sunflower olive (*Helianthus annuus*), it concerns the most known and significant representatives of a sort sunflower (*Helianthus*). Being the near relation of sunflower, topinambour (often named also «an earthen pear») represents long-term tuberiferous a family plant. Compositae, possessing powerful root system and reaching in height to 3-4 meters.

The native land of topinambour - the North America where it grows in a wild kind. For the first time root crops of an earthen pear were used in food from outside by the Brazilian Indians - of an American Indian tribe «tupinamber», using in food tubers topinambour. The name «topinambour» has been given a plant in a random way when in a XVII-th century Indians of the Brazilian tribe of Tupinambus have been brought to France. Tubers of an unknown plant which began to call a word «topinambour» - derivative of the tribe name have been found out in them.

To Europe topinambour has got in the XVII-th century beginning thanks to the traveller and pioneer Samjuelju de to Shamplenu, which have sent tubers topinambour from Canada to France and for the first time compared them on flavouring qualities with an artichoke (and most likely thanks to such comparison since then topinambour in Europe it is more known as «the Jerusalem artichoke»). Since then for more than 500years cultivation of rather unpretentious growth to conditions topinambour was widely adopted in many countries of Europe (and together with the increased popularity at Europeans topinambour also has received also other names among which - «the Canadian potato», «jirasol», «a solar root»). In Europe and to this day from cultural grown up topinambour make fructose, spirit, liquor, wine and beer, and also tubers of this plant throughout many years are traditional components of dishes Belgian, Dutch, French, German and English cuisine.

Thanks to the active scientific researches of biochemical structure developed recently and treatment-and-prophylactic properties

topinambour interest to this unique dietary foodstuff has substantially increased in Canada, the USA, Brazil, China, India, Japan, Russia, Belgium, Holland, Germany, Hungary etc.). And received from topinambour and irreplaceable for sick of a diabetes inulin has been officially recognised in many countries of the world by absolutely safe for the person by a food component. Topinambour in the World cultivated in more than 2.5 million hec.

Topinambour in Tajikistan

Under the message of the doctor of Litvinov V N (1958) topinambour to Tajikistan has been brought by migrants from the Russian Federation as early as the twentieth years of the XX-th century. Then basically it was grown up as an ornamental plant from the population.

In 1950 A.P. Saverkin has obtained the important scientific data about good growth topinambour on a number with other food cultures in a mountain zone to the Gissar valley at height about 3000 m above sea level.¹ In 1953-1955rr. In the conditions of the Gissar valley of our republic on an experimental site special experiments on studying topinambour have been made. Those years to collective farms and state farms were on 5000 kg tubers topinambour for cultivation and reproduction.

Within 1956-1958 topinambour it was grown up in the conditions of Gissar and Vahsh valleys, in area Garm, in Leninabad area and in the Western Pamir. Then from crops topinambour in collective farms, state farms and on skilled sites it has been received on the average on 50Mt a biomass and on 25Mt tubers about 1 hectare.

In conditions areas-Ishkashim, Rashtkalin and Shugnan about 1 hectare topinambour it has been received on 50-60Mt green mass weights and on 15-20Mt tubers.¹

The conducted researches by the Tadjik scientist A. Ergashev² in the conditions of high mountains (village Siyohkuh of Varzab area) have shown high factor of an economic crop topinambour (K_{hoz}) at an irrigation 0.37-0.41 and in conditions rain field 0.33-0.39 that it testifies to high intensity of photosynthesis of this plant. Our research

have shown that till now in many areas of republic topinambour is grown up from the population as decorative culture.³

Botanical characteristics of topinambour

The elevated part topinambour on appearance reminds sunflower, the downy stalk branched out on a top in length from 1,5 to 3m; the bottom leaves of heart-shaped-jajtsevidnoj form, top large, length 10-20sm and width 5-12sm, on edge gear, petiolar, dark green colouring; the inflorescence - a basket, diameter 1-1,5sm, consists from yellow flowers. Flowering later, in September-October. A fruit - seeds. The root system rod, gets on depth to 2m, forms numerous underground runaways (stolones) on which tubers are formed from 10-30 and more. Under the form tubers can be pear-shaped, verities, roundish, with strongly pronounced convex kidneys-eyes, colouring varies from white and yellow colour to rose-red and violet (mainly pulp white, and a skin yellow-brown). Weight of tubers from 10 to 150 g depending on a grade, a zone of cultivation and agricultural technicians. Now by selectors are deduced more than 300 grades topinambour.

Tubers topinambour contain in the structure: inulin (11-17 %), fructose, saccharides, amino acids (to 8 %) (including 8-irreplaceable amino acids-arginin, gistin, valin, leicin, izilecin, triptofan, methionine and fenilalalin), karotinoids, vitamins B₁, B₂, B₃ (PP), B₆, B₉, With pectins (to 10 %), organic acids (lemon, malinovaya, apple, amber, fumarovya, fat acids (0,4 %-0,7 %), nitrogenous substances, cellulose (to 6 %), and also rather wide set of makro y microcells (potassium, sodium, magnesium, iron, phosphorus, manganese, calcium, silicon, copper, zinc, sulphur, chrome, iodine, a pine forest, aluminium, cobalt, molybdenum, fluorine, etc.). By quantity of vitamins C, B₁ and B₂ topinambour more than in 3 times surpasses a beet, carrots and a potato.⁴

Topinambour as food and feed crops

Now topinambour it is cultivated in many countries of the world. The earthen pear essentially surpasses a sugar beet, corn and a potato in productivity, and on food value tubers topinambour are in the lead among the majority grown up on territory of Russia of vegetables. Also topinambour often land for increase of fertility of agricultural grounds, for protection of crops against winds, and also sometimes use for decorative gardening of city parks and rest zones.

Containing in the structure a considerable quantity of pectin's tubers topinambour are used in fruit candy manufacture, jelly, jam and jams for dietary and baby food. Besides, topinambour already throughout many tens years application in the bakery, meat, dairy and canning industry finds, is used in manufacture alcoholic and soft drinks, in manufacture of various biologically active additives. In pharmaceutical industry tubers topinambour are used basically as a source inulina.

But it is traditional in cookery of many countries of the world tubers topinambour already throughout many centuries find more various application. It is necessary to note, as at such various kinds of culinary processing root crops topinambour not only keep substantially the food value and weight of curative properties, and also get more sated taste and aroma in comparison with fresh tubers of this plant.

Fried and baked tubers topinambour use as a part of stuffings for pies, pies and fritters. From an earthen pear prepare also creams-soups, kissels, jam, compotes, kvass, mashed potatoes, cutlets, fritters, baked puddings, various garnishes for the second dishes.

In the USA and other countries of the world the crushed tubers topinambour from which prepare tasty dietary coffee enjoy wide popularity dried, and then.

House batch, in which preparation the powder topinambour is used (the dried up and crushed tuber topinambour) long does not harden (it is connected by that fructose a part to an earthen pear promotes long deduction of a moisture by the baked bakery products).

It is necessary to notice what to clean a tuber topinambour because of its freakish, knotty form difficult enough (for simplification of this procedure is better to scald preliminary topinambour on a frying pan and then to clean off from it a peel thus, as usual peel young potatoes).¼ unit is recommended for preservation of the maximum advantage of a tuber topinambour only carefully to clear it of the soil rests under flowing water by means of a rigid brush and to use this root crop in the culinary purposes directly with a peel representing really a well so necessary organism to person of silicon, iron and other useful substances.

The study results of topinambour in conditions of Tajikistan

Considering useful properties topinambour us there was an object in view - to study feature of growth and development topinambour in the conditions of Gissar and Rasht valleys of Tajikistan on watering and without watering, as food and fodder culture (at height of 820-2700 m above sea level).

The following entered into a problem of experiences:

- To choose different variants of entering of mineral fertilizers under topinambour,
- To spend planting to spend accounts of approach of the basic growth phases and development topinambour (shoots, branching, бутонизации, flowerings, formations of tubers),
- To define dynamics of formation of a biomass in the basic phases of development a plant,
- To carry out the biochemical analysis of tubers and elevated weight of plants,
- To spend the description of a plant during vegetation,
- The account of productivity and efficiency of plants.

Material and technique of a bookmark of experience

As material for carrying out of our researches tubers of a grade "the Interest", grown up in the conditions of Javanese area served. Tubers of the given grade topinambour are got by us at Public organization (NGO) «Is advisory - the Information Network» ("PUSSYCATS").

Experiences on studying of feature of growth and development topinambour have been put in the conditions of Gissar and Rasht valleys of Republic Tajikistan.

On the basis of skilled a site of Institute of botany, physiology and genetics of plants of NAS of Tajikistan located in Dushanbe experience with following variants has been put:

- Planting topinambour without watering (rain fields);
- Planting with watering carrying out.

At landing of tubers topinambour used following norms of entering of mineral fertilizers on a site without watering:

- Without fertilizers (control),
- Entering NPK (50:50:25kg/hectare) in the form of operating substances,
- Entering NPK (75:75:50 kg/hectare) in the form of operating substances,

- iv. Entering NPK (100:100:75 kg/hectare) in the form of operating substances,
- v. Entering organic fertilizers (a liquid from a water solution a plant ejhornija-2 from calculation of 5 litres on 10 metres).

Frequency of experiences triples and randomize. On a site with watering put experience with following schemes of landing: the landing scheme: 70x20sm; 70x30sm; 70x40sm.

Also here on this skilled site liquid organic fertilizer (a liquid of a water plant - ejhornija-2 from calculation of 5 litres on 10 running meter is introduced. Ploughing skilled a site have spent on April, 5th by means of wheel tractor MTZ-82 on depth 25 sm for soil preparation have spent at first ploughing and have every other day spent processing fields and the furrow by means of a cultivator KNS - 4,2 cut. The rows for landing topinambour have spent on depth of 10-15 sm under the scheme of 70 sm between numbers. The tubers topinambour have been planted on a skilled site manually in cut ready for landing of numbers. Workers on buckets took tubers topinambour and manually on one piece put in the middle of the cut furrows, and then also have manually covered tubers with soil with the help tools. Tubers were the covered soil approximately 5-7 sm.

Technique of a bookmark of experiences in the Rasht valley

Experience is put on April, 25th, 2012 in the conditions of village “Sasybulak” jamoat by “Muksu” of Jirgital area. Experience consisted

of two parts: a landing site topinambour without watering (rain the earths, the earth sandy at height of 2000 metres above sea level) and landings to a site with watering carrying out (at height of 2200 metres above sea level), and also on rain (at height of 2700 metres above sea level). The planting scheme is 50x20sm.

The study results in Gissar valley

As have shown researches growth and developments topinambour pass in the Gissar valley normally in spite of the fact that landing has been spent rather late.

From Figure 1 it is visible that in the beginning of June on height of plants between variants of experience of an especial difference it is not observed. However, since beginning of July the height of plants in a variant with watering amplifies also it is observed till the end of vegetation. The height of plants in variants in a shade is much less, than at variants without a shade - without watering and in a variant with watering. Thus, the tree shade negatively effects on growth and development of plants topinambour, and watering promotes considerable strengthening of growth of plants almost during all vegetative period topinambour. In variants in a shade - without watering and without a shade, without watering because of lacks of a moisture of soil, growth of plants proceeds to grow to the beginning of August, and then it does not increase and stabilized at one level. In a variant with watering height and growth of plants during the period August - October increases also it proceeds before the vegetation termination. Thus the soil moisture and watering play an important role in accumulation and dynamics of growth of plants topinambour.

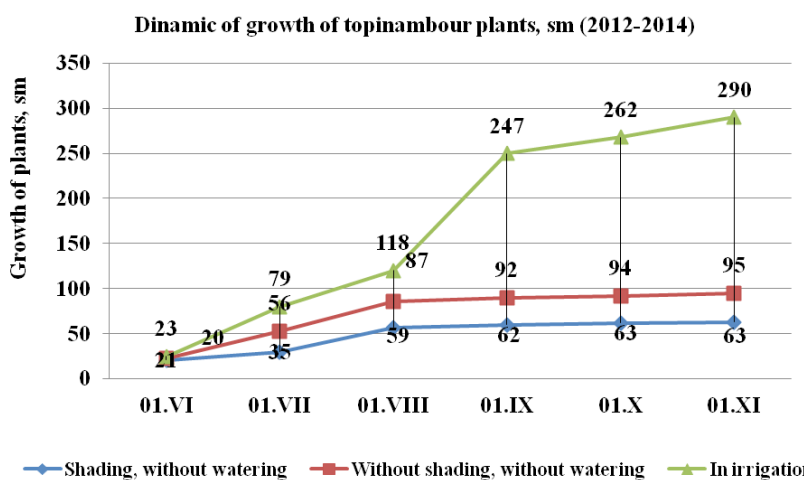


Figure 1 Dynamics of growth of plants topinambour in the conditions of the Gissar valley.

From Figure 2 it is visible that in June by quantity of leaves on one plant between variants of experience of an especial difference it is not observed. However, since beginning of August of quantity of leaves at plants in a variant with watering increases intensively and it proceeds till the end of vegetation. The quantity of leaves in variants in a shade is much less, than at variants without a shade - without watering and with watering.

Thus, the tree shade also negatively affects on formation of quantity of leaves at plants topinambour, and carrying out of watering promotes considerable strengthening of process of formation of leaves at plants. In variants in a shade - without watering and without a shade - without watering because of lacks of a moisture of soil the quantity of leaves on plants proceeds to increase prior to the beginning of August, and then does not increase quantities of leaves and keeps at

one level. In a variant with watering of quantity of leaves in July - October increases also it proceeds before the vegetation termination. Thus, watering have played an important role increase in quantity of leaves topinambour.

From Figure 3 it is visible that on the basis of the general biomass between variants the essential difference is observed. In a variant in a shade - without watering the poor harvest on the general biomass, than in variants without a shade - without watering and in a variant with watering (accordingly on 52 % and 97.9 %) and accordingly and on a crop of tubers (on 70.0 and 184.2 %) is observed. Thus, the tree shade negatively influences formation of the general biomass topinambour. In a watering variant the general biomass at topinambour increases by 30.2%, and a crop of tubers on 72.9% than in a variant without a shade-without watering.

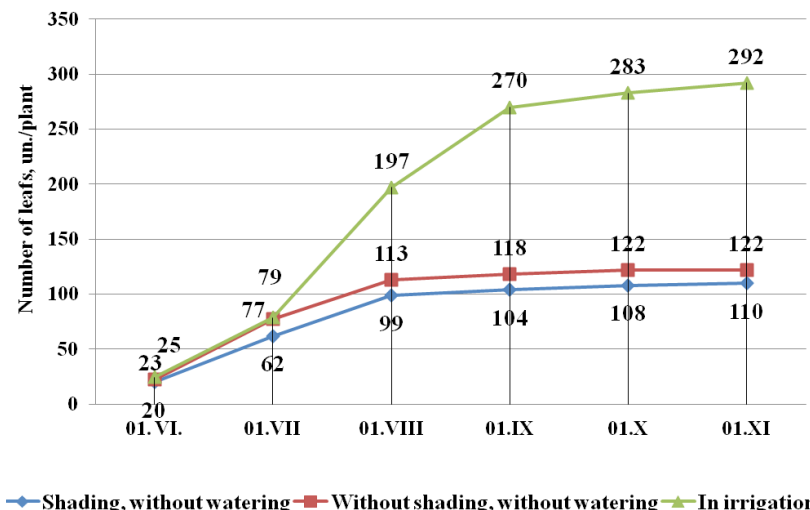


Figure 2 Dynamics of increasing of number leaves of topinambour in the conditions of the Gissar valley.

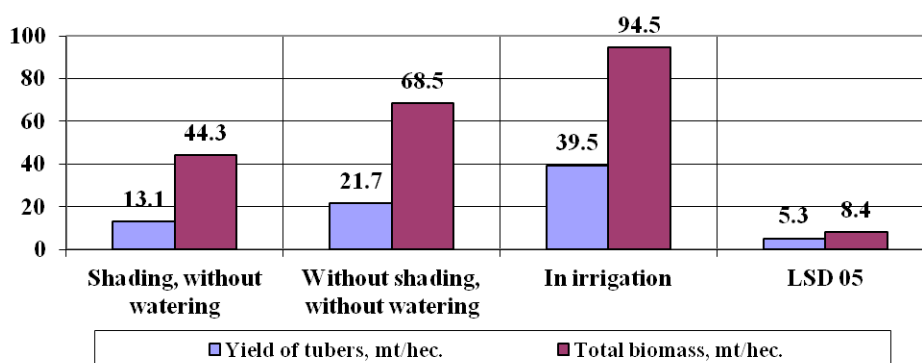


Figure 3 Yield of biomass of topinambour under doses NPK-II.

Thus, watering plays an important role in growth and development strengthening and efficiency increase topinambour in the conditions of the Gissar valley of Tajikistan.

Apparently from Figure 4 topinambour well developed and accumulated a good harvest of a biomass in the end of vegetation to the beginning of November. Duration of the vegetative period from shoots of plants has made more than 165 days.

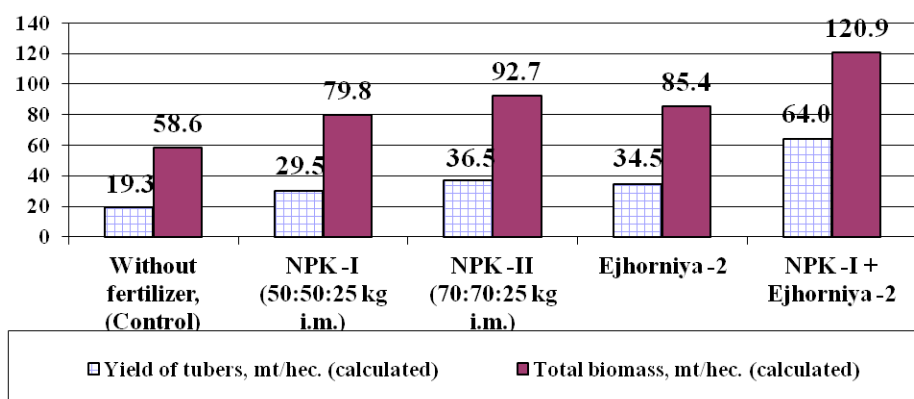


Figure 4 Influence of fertilizer to yield of topinambour, mt/hec.

Influence of fertilizers for productivity of biomass topinambour

As have shown our researches entering of mineral fertilizers (NPK) and organic fertilizers - ejhorniya-2 are rendered by a positive

effect on growth and plant development topinambour. In particular at joint entering of mineral fertilizers (NPK-I), (NPK-II) and organic fertilizer - ejhorniya-2 is observed increase in height of plants at 56 sm or at 25 % in comparison with a variant without entering of mineral fertilizers.

In particular on the general biological weight of plants topinambour essential influence has rendered joint entering of mineral fertilizers with organic fertilizer (ejhornija-2) that is visible from mentioned below Figure 4.

Apparently from Figure 5. Joint entering of organic-mineral fertilizers (NPK-I + ejhornija-2) leads to substantial growth of the general biomass topinambour in comparison with variants without entering of mineral fertilizers (on 161.2 %) and with entering of mineral fertilizers NPK-I (on 94.9 %), NPK-II (on 64,7 %) and ejhornija-2 (on 77.8 %) separately.

Also joint entering NPK-I + ejhornija-2 leads to substantial growth of a crop of tubers topinambour in comparison with variants without entering of mineral fertilizers (in 5,1 times) and with entering of mineral fertilizers NPK-I (in 3.4 times), NPK-II (in 2,5 times) and ejhornija-2 (in 2,7 times). Thus, the most effective variant considers joint entering of organic-mineral fertilizers (NPK-I + ejhornija-2) under topinambourom at watering of plants. In this variant it is observed increases in productivity of the general biomass at 161.2 % and productivity of tubers more in five times than in control (without application of fertilizers).

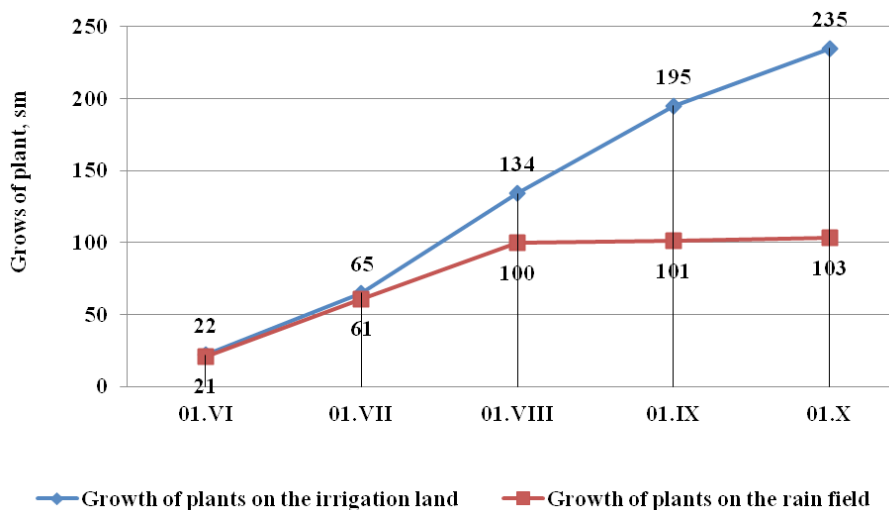


Figure 5 Dynamics of grows of plant topinambour.

At joint entering natural - mineral fertilizers (NPK (50:50:25 kg i.m.) + ejhornija-2) almost twice increases weights of tubers from the general biomass of plants, than in a control variant. Thus also it is observed reduction of weight of roots, leaves and stalks, than in control. Almost such change in a parity of formation of bodies of plants topinambour from the general biomass is observed and at entering of organic fertilizer ejhornija-2 in the pure state. Thus, stimulating action of organic fertilizer ejhornija-2 on formations of a crop of tubers from the general biomass of plants topinambour is observed that has great value in increase in an exit of tubers from area unit.

Growth and development topinambour in the Rasht valley Jirgital district

In the conditions of Jirgital area landing topinambour was spent on April, 25th, 2012 in village «by Sasyk - rolls», jamoat «Torments-sous» of Dzhirgatal area at height of 2100 metres above sea level. Soils of this site according to soil a cartogram concerned to mountain карбонатным to soils and in them pH=6,8. The Amount of precipitation in a year there will drop out about 400mm.

Tubers topinambour in the conditions of watering have spent on приусадебном the ground area of the local farmer of the given village Mahramov Idibek. Soils skilled sites concerned group mountain carbonate soils.

In the conditions of watering on a site of farmer Mahramov I. mass shoots topinambour it is noted in a month from landing as year was too cold and with a small amount of precipitation within May - July, than

normal years that has led to a delay of shoots of tubers topinambour. We had been spent on September, 20th, 2012 survey of a skilled site without watering (on rain earth) and on watering at height of 2100 metres on a sea level in the Lahsh file of Jirgital area.

On rain field plants of topinambour despite shortage of a moisture, nevertheless had growth of plants to 60-80sm, blossomed and formed till 7-12 piece of tubers. And in the conditions of plant watering reached height of 260sm and intensively blossomed.

Plants topinambour well developed as well in the conditions of watering at height of 2700 metres above sea level and their growth has reached heights of 200sm.

As show the data fig.5 at watering dynamics of growth of plants topinambour since the beginning of July quickly it grows also proceeds till the end of vegetation. In a variant without watering since the beginning of August dynamics of growth of plants is stabilized and till the end of vegetation almost remains at the same level.

From Figure 6 it is visible that the quantity of leaves at watering since the beginning of June prior to the beginning of October increases by one plant, and at landing on борape increase the quantity of leaves is observed prior to the beginning of July, then this indicator is stabilized at one level till the end of vegetation. Hence in the conditions of a mountain zone at cultivation topinambour on rain conditions it is possible from the beginning of August an elevated part topinambour to mow down for use on a forage of cattle or for other purposes, and at watering of it is possible to make for two months later.

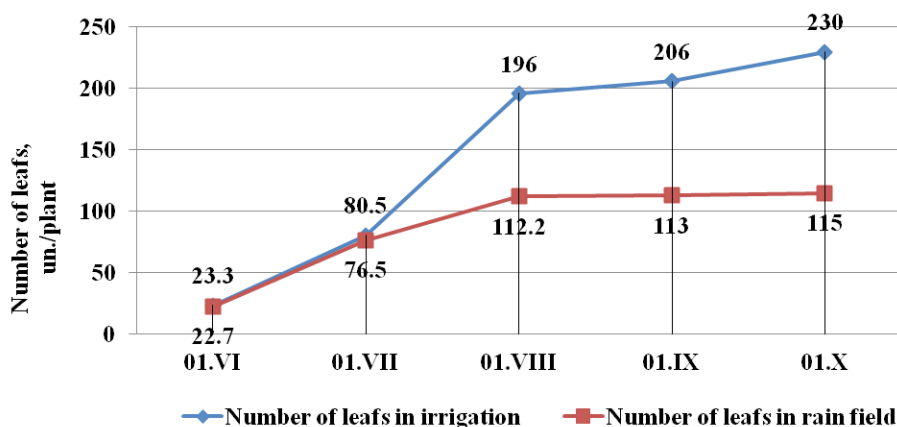


Figure 6 Dynamics of formation of number leaves of topinambour, Jirgital district.

From Figure 7 it is visible that on the average the biomass crop topinambour on rain field the irrigation land makes 48.4 t/hect. that testifies to utility of cultivation topinambour on rain field. Also it is

established that watering promotes increase in a crop of a biomass topinambour on 29.1 t/hectares (or on 60.1 %), in comparison with planting on rain land.

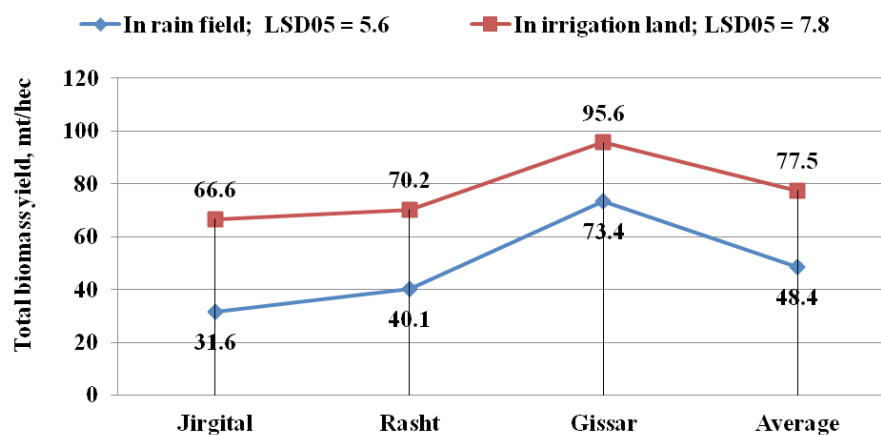


Figure 7 A biomass crop topinambour on rain field and in irrigation land, mt/hect. (calculated).

From Figure 8 it is visible that on the average the crop of tubers topinambour on bogarnykh the earths make 16.3 t/hectares that testify to a high indicator of efficiency topinambour on bogarnykh the earths.

It is established that watering promotes increase in a crop of tubers topinambour on 14.2 t/hectares (or on 87.1 %), in comparison with landing on rain lands.

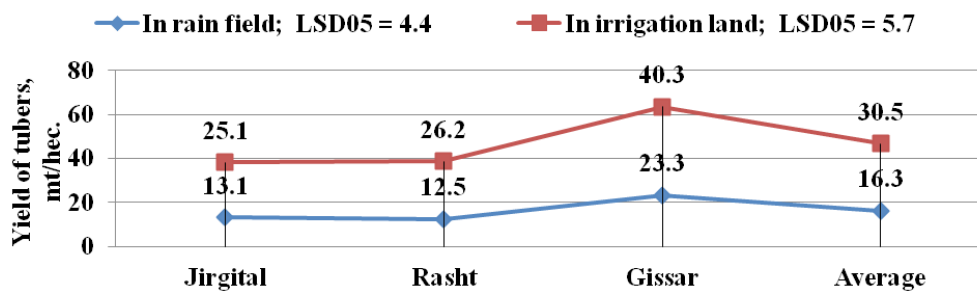


Figure 8 Yield of tubers in rain and irrigation lands, mt/hect (calculated).

Approximately from the general biomass of plants topinambour different parts or bodies make following quantity: roots approximately 23-25 %, leaves - 14-16%, stalks 22-23% and tubers - about 38 39%.

Thus, the cultivation variant topinambour on the irrigation earths has not led to essential change of parities of parts of plants from the general biomass in comparison with cultivation variant on rain the earths.⁵

Conclusion

1. At cultivation topinambour on watering essential strengthening of dynamics of growth of plants, formations of quantity and the area of leaves, biological efficiency and productivity in comparison with cultivation on rain the earths is observed.
2. In conditions in a shade and without watering carrying out essentially inhibited of growth and developments of plants, efficiency and productivity of plants, than in the conditions of cultivation without a shade without watering and on watering.
3. Joint entering of organic-mineral fertilizers (NPK-I + ejhornija-2) on watering to lead to increase in the general biological weight topinambour in comparison with variants without entering of mineral fertilizers (on 161.2 %), with entering of mineral fertilizers NPK-1 (on 94.9 %), NPK-II (on 64.7 %) and ejhornija-2 (on 77.8 %) separately.
4. Also joint entering NPK-I + ejhornija-2 leads to substantial growth of a crop of tubers topinambour in comparison with variants without entering of mineral fertilizers (in 5.1times) and with entering of mineral fertilizers NPK-I (in 3.4 times), NPK-II (in 2.5 times) and ejhornija-2 (in 2.7 times). Thus, the most effective variant considers joint entering of organic-mineral fertilizers (NPK-I + ejhornija-2) under topinambourom at watering of plants. In this variant it is observed increases in productivity of the general biomass at 161.2 % and productivity of tubers more in five times, than in control (without application of fertilizers).
5. Stimulating action of organic fertilizer ejhornija-2 on formation of a crop of tubers from the general biomass of plants topinambour on watering that has great value in increase in an exit of tubers from area unit is observed. At joint entering organic - mineral fertilizers (NPK (50:50:25 kg/hect.) + ejhornija-2) almost twice increases weights of tubers from the general biomass of plants, than in a control variant.
6. Different parts of plants topinambour from the general biomass are distributed by a following parity: roots of 23-25 %, leaves - 14 - 16 %, stalks – 22-23 % and tubers – 38-39 %. The cultivation variant topinambour on the irrigation earths has not led to essential change of parities of parts of plants from the general biomass in comparison with a cultivation variant on rain the earths.
7. The general crop of a biomass topinambour on the irrigation earths of the Gissar and Rasht valley fluctuates within 66.6 - 95.6 Mt/hectares, and on rain the earths - 31.6 - 73.4M t/hectares. On the average the biomass crop of topinambour (sun artichoke) on watering makes 77.5 Mt/hectares, and on rain the earths - 48.4 Mt/hectares that testifies to efficiency and utility of cultivation topinambour on irrigation and on rain the earths of Tajikistan.
8. Watering promote increase in a crop of a biomass topinambour on 29.1 Mt/hectares (or on 60.1 %) a crop of tubers on 14.2 Mt/hectares (or on 87.1 %) in comparison with cultivation without watering.
9. The weight and tubers topinambour with the big hunting are eaten by animals, rabbits and birds and topinambour the animal industries and receptions of a biomass for synthesis of biogases and bioethanol in the conditions of Tajikistan in the future are highly effective culture for strengthening of a forage reserve.

Acknowledgments

None.

Funding

None.

Conflicts of interest

All author listed here declare no conflict of interest exists.

References

1. Litvinov VN. Feed crops in Tajikistan. *Dushanbe*. 1965. 295 p.
2. Ergashev A. Intensive and dynamic of formation of photosynthesis production of sun artichoke. *Physiol and biochim of plants*. 1976;3(8):299–303.
3. Partoev K, Saidaliev N, Rakhimov A. Yield of sun artichoke (*Helianthus tuberosus* L.) in conditions of Gissar and Rasht of Tajikistan. *Almati*. 2013:437–440.
4. Raingart ES, Kochnev NK, Ponamarev AG, et al. The perspective of using of sun artichoke for bioethanol production. *Moscow*. 2008:38–40.
5. Partoev K, Yasinov ShM, Khotamov UA. Sun artichoke - efficiency crops. *Dushanbe*. 2015. 32 p.