

## BIOMORPHOLOGY AND PERSPECTIVES OF GROWING *TARAXACUM KOK-SAGYZ* RODIN. IN THE SOUTHERN KAZAKHSTAN

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**Abstract.** This report was given on the international scientific conference 15-17 November 2013 in the Beregovy town (Ukraine), Transcarpathian ugor institute of France Racoshy. In this report perspectives of growing and the ways receiving more mass specific clean seeds of the *Taraxacum kok-sagyz* Rodin are considered.

With development of industrial production in the world, the consumption has been grown in natural caoutchouc (rubber). Classic source of natural caoutchouc is a plantations of para rubber tree in the future will not provide already growing necessity in this raw material. In connection with this, a demand arose to get caoutchouc from alternative sources. The interest was expressed to *Taraxacum kok-sagyz* Rodin, early has been grown at many countries including Kazakhstan.

This is young, progressing endemic and rare in flora of Kazakhstan perennial rosette plant, height is 10-16 sm, valuable caoutchouc, containing insulin, important resource specie. Even in 2005-2006, foreign scientists organized a crew in Northern Tyan-Shan in search of tangles of this plants (1). European, botanists from the USA, Albania, organized a crew in south-east Kazakhstan and made a collection of materials from 22 populations of *Taraxacum kok-sagyz* Rodin (2).

In 2008, EU developed a project: «**The production and development of alternate sources of caoutchouc and latex in European Union**» and created **Consortium EU-PEARLS** in order to perform this project. 12 research organizations from EU and Organization Centre "Ecologic Reconstruction" from Kazakhstan took part in this Consortium.

In the framework of tasks **Consortium EU-PEARLS** on project, botanists from Kazakhstan together with Czech botanists (participants of Consortium) from 23<sup>rd</sup> of May on 22<sup>nd</sup> of June, 2008 fulfilled a study of expansion and position of population of *Taraxacum kok-sagyz* Rodin (3).

*Taraxacum kok-sagyz* Rodin was discovered and described in 1931 by L. Y. Rodin. It grows in alkaline grounds, gravels, tangles of cheegrass, valleys of mountain rivers and on northern hillsides. In Tyan-Shan, the habitats were marked in Kugaly, Saryzhaz, near Kegen village, Dzherkentskiy, between Chuladyr river and Kegen village, valley of river Karkary ravine Kyzyl Auyz pass over Jungaly, pass Kyzyl Art, Oikaiyn [5]. The basic components in assemblages of *Taraxacum kok-sagyz* Rodin are: *Lasiagrostis splendens*, *Elymus Regelii*, *Artemisia Shrenkiana*, *A. rupestris*, *Ranunculus cymbalaria*, *Potentilla anserine*, *Caragana aurantiaca*.

Raimbek region, where our research investigations were conducted (3), is related to the south and west part of Almaty region. Geographically, this region represents Kegen - Tekess high mountain river valley. The height above sea level is 1800-1845 m. The climate of this region is very continental, has some specifics. Nevertheless, that region is located at big heights, totally, for all year rainfalls are 336-433 mm<sup>3</sup>. The average amplitude of temperature per year is 29°. These features are near to flat land and connected with climatic inversion, when wet airflows cannot penetrate in high-mountain valleys. The average temperature per year is low, approximately 2,5°. Winter is cold, average temperature of most cold

month (January) is  $-15^{\circ}$ , and warm (July) – not more  $+14,5^{\circ}$ . Absolute minimum decreases up to  $-44^{\circ}$ , and maximum reaches up  $+35^{\circ}$ , absolute oscillations – up to  $79^{\circ}$ (6).

*Taraxacum kok-sagyz* Rodin represents extremely polymorphic species, very variable, especially on shape of leaves and anthode (7), has a wide diapason of ecologic amplitude. It grows in various, soil conditions within limits of its areal - from wet meadow soils ( in stow Saryzhaz) and alkaline submontane chestnut soils with chia- absinthial vegetation (Oikaiyn stow) and alkaline lakeside soil in area of salt lake (3). At sod fields, some items of kok-sagyz had huge dimensions, in rosette has approximately up to 129 leaves and 96 floriferous arrows, they are varied by great anthode and plumpness of seeds [8]. This certifies about high grade of changeability and response of *Taraxacum kok-sagyz* Rodin in conditions of environment, possibility to select on productivity.

The vegetation period of kok-sagyz is expanded, without clearly defined period of quiet. The vegetation of plants begins from mid-April and terminates on late fall. The last flowering is on the beginning of August and mid-September. At one plant may see an appearance of but, simultaneously arrows with anthode in flower and even bearing a seeds

We calculated an age composition of taraxacumkok-sagyzRodin in two typical natural species of population (6).

1. In Oikaiyn stow, *Taraxacum kok-sagyz* plants were grown on alkaline hills with chia plantations, edging a hollow with meadow vegetation. There are  $1 \text{ m}^2$  35-37 species, located by groups often. This creates an impression about possible burr reproduction. The age composition: sprouts – 0 (seeds are not maturated, the plants just begin a flowing), juvenile- 3 5, young generative – 37, mid generative - 25 и senile - 3 percent.

2. In valley Tekes, at the center of areal, the plants are located more compactly and at area  $1 \text{ m}^2$  has been grown from 35 up to 75–80 species. From them: sprouts - 12, juvenile - 40, young generative – 25, mid generative – 18 and senile - 5 percent.

In average 25-30 species kok-sagyz are allocated at  $1 \text{ m}^2$ , and sometimes 220 species [6]. So, the analysis of age composition of cenopopulation of *Taraxacum kok-sagyz* Rodin, shows stable position of its cenosis in natural ecosystems.

The one of the distinctive coenotic specialties of *Taraxacum kok –sagyz* Rodin is advantage compactly- grouping location in cenosis. This is connected with stuntedness of plants, short flower-bearing stem, that has been stipulated more close to stool seeds dispersal. This plant is always softly closed by leaves of associated grasses, that provides their weak shadow effect.

Dynamic position of *Taraxacum kok –sagyz* Rodin population has progressing tendency. By reduction of forage plants (*Festuca alata*vica (Hack) , *Koeleria gracilis* Pears, *Phleumpratensis* L.) in stows at the result of pastoral degradation, Taraxacum species occupy discharging niche including kok-sagyz. Consequently, these species have not only high stability to anthropogenic influences, but has a pioneer character of expansion, intensively populating a free niches. Therefore, these species are appeared in waysides, around waste deposit, recreatively degraded lands, rarely in villages.

*Taraxacum kok –sagyz* Rodin is moisture-loving, mesofilic, freeze and heat stable plant, has wide diapason of ecological amplitude that has been given an opportunity to cultivate these species in multiple climatic areas.

Due to growing needs in the world for high-quality natural cautchouk we put a question to create industrial plantations for *Taraxacum kok –sagyz* Rodin in Kazakhstan, native country of this plant, where this specie was cultivated previously and has an experience of its cultivation (9). For this, at the first , it is need to get big mass of seeds at the first years of cultivation of *Taraxacum kok- sagyz* Rodin, creation of seed-stock by seed collection from more developed species.

A the initial stage of these works, seeds collection is made from natural population species. The plants grew from these seeds are heterogeneous. Therefore, it is need to make permanent selection of plants in plantation with more great roots, get going selection work. It is need to multiply such seeded plants by vegetative – grafting of roots, in order to keep a properties of plants, seeded for cautchouk. The cultivated plants are relocated at queen area for purpose to get a seeds adequate plants, contained a cautchouk in the future. In order to get a big mass of seeds at the first year, it is need to cultivate *Taraxacum kok-sagyz* Rodin in the regions with long vegetative period for purposes to collect two harvest of seeds per year.

In the regions of irrigated farming, and with more long vegetation period, it has a possibility to get two harvests per year. For this, we recommend to make planting method of growing of plants for winter period in greenhouse. On spring, the transplanting of seeds has been conducted for permanent place in ground.

### **1. The experience of growing of plants by transplanted method.**

The seeding was conducted on laboratory conditions at peat blocks with 4-5 seeds for each block and in the further, the seedlings were grew in germinating cabinets. The observations over dynamics of germination of seeds and development of seedlings showed as follows:

- The seeding 09. 02.09;
- Emergence of seedlings 13. 02.09;
- Mass emergence of seedling 15.02.09;
- Appearance of first true leaf 17.02.09;
- Appearance of second true leaf 26.02.09;
- Appearance of third true leaf 08.03.09;
- Appearance of forth true leaf 15.03.09;
- Appearance of fifth true leaf 24.03.09;
- Appearance of sixth true leaf 05.04.09.

As seen from these observations, seeds of Dandelion kok-sagyz have quick speed of germination and dynamic formation of leaves. After each 7-9 days, new leaves are appeared. As well as intensive development of root system has a place.

It is deemed that a germination of seeds from angiosperms begins from appearance of root. So, at the moment of emergency of seedlings (seed lobes) the length of root is 1- 1,2 sm, hypocotyl becomes drawn up to length 0,6 – 0,7 sm. The seeds, laid by seeding on the level of ground, to be drawn at ground on the deep 0,4 – 0,5 sm.

With appearance of third true leaf ( some species and second leaf) lateral roots begin to be formed. The formation and development of lateral roots are basic processes, stimulating an increase of absorbing surface, need for provision of intensively growing above- ground part of water and elements of mineral feed.

With appearance of 5-6 leaves, basal part of main root begins to be thicken, accumulation of caoutchouk gradually occur. This transfer of plants in immature position of development.

Therefore, close correlative relation exists between dynamics of development of above-ground and underground organs of plants. The appropriate appearance and development of elements of root system were preliminary to appearance and growth of new parts and organs in above-ground sphere.

On 04<sup>th</sup> of April, 2009; the peat blocks with seedlings, cultivated there, were transplanted in ground at botanic garden of Turkestan. The first two weeks after seeding of plants, it is observed a slow growth of plants. After 20-25 days, the growth to be fasten. The first leaves, formed after transplanting , were plain leaves, the next leaves became with various grade of emarginated and even blazed.

The commencement of formation of flower-bud, cultivated in ground is 10<sup>th</sup> of May, mass appearance of flower-bud is 16-18 of May, commencement of flowering is – 28<sup>th</sup> of May. The flowering of plants is not simultaneous and extended up to end of June. After 10-15 days after flowering, fructification begins, which continues up to end of July. From 25 up to 45 leaves are appeared at one adult plant, and 11-12anthodes.

In fall, the leaves of yearling plants will be redden, dried and dropped.

On the second age of life (2010) the leaves begin to grow very early –on the beginning of March, even under snow and 7-8<sup>th</sup> of April, the plants already began to transfer at the phase of formation of flower-buds. After 6-7 days, the flowering began and at the end of May, the seeds commenced to mature.

The duration of vegetation period of plants with second age is 95-96 days. This permits to make summer seeding and get second harvest of seeds, that is very important for acceleration of process for creation of industrial plantation of *Taraxacum kok –sagyz* Rodin.

### **2. The experience of reproduction of multiplication by root cuttings.**

The specialists, worked early on cultivation of *Taraxacum kok –sagyz* Rodin, noted its high regeneration capacity of this specie, when retrenched and earthed roots grew and gave new plants. It is

recommended to take a roots from yearling for grafting. The length of quicksets must be not less 2-4sm, and its weight not less 0,25gr and not more 0.5gr. (7).

For vegetative reproduction of plants by root cutting, it is taken a roots from normally developed plants and each plant will be visually controlled for contents of caoutchouk in the root, rubber- containing and ill plants will be not taken into attention.

In order to determine a contents of caoutchouk, root cortex will be softly broken and drawn every which way. The plants, containing a caoutchouk, elastic fibers of caoutchouk will become drawn, holding a cortex from bruise.

The experience on cutting grafting of roots was conducted in 2012 on the following scheme.

1. 02<sup>nd</sup> of May the root cutting with length: 4-4,5sm: 1- from top part, 2- middle part, 3- low part (above tension area) of main root were cut. Lateral roots from root cutting were removed by cutting of fine edge. The sprigs from low part of main root were cut not out edge of lateral root formation and transplanted in plastic boxes, filled by soil;

2. 12<sup>th</sup> of May, the leaves were appeared and at the same time- little radicles.

3. 22<sup>nd</sup> of May, we calculated: from 20 radicles with top part, the leaves and roots of 15 plants were formed, the length of roots : 4-5sm: from 20 sprigs of middle part, the leaves and roots of 16 plants were formed, the length is 12sm; from 20 spring from low part, the leaves and roots of 13 plants were formed, the length is 2-3sm.

4. 12<sup>th</sup> of June, the cuttings from top part of main root formed up to 12 leaves and 22 roots, the length of most great from them is up to 10sm., branch out is large-handed, the length of lateral roots is up to 4 sm.;

The sprigs of middle part of main root formed up to 9 leaves and 13 roots, the length of most great from them is up to 6sm., branch out is average, the length of lateral roots up to 2sm.;

The sprigs from low part of main root formed 9 leaves and 10 roots, the length of most great from them is up to 5sm., branch out is weak, the length of lateral roots is up to 1-1,5sm.

### 3. The experience of transplanting of whole *Taraxacum kok kok - sagyz* in ground.

This experience was conducted at the beginning of works, when from natural populations, the plants were selected on contents of caoutchouk in the root.

Therefore, *Taraxacum kok-sagyz* is rare plant included in Red List of the Republic of Kazakhstan, for withdrawal of plants from natural populations, it is need to get a permission from Government. By Decree of Government of the Republic of Kazakhstan dated 09.07. 2009 under № 1046, Organization Centre «Ecological Reconstruction» obtained a permission to collect *Taraxacum kok-sagyz* in number: 750 roots for research purposes.

Upon out planting of seeds and adult plants for transplantation, it is recommended to water largely and obligatorily an areas from which the seeds were taken. By this, the roots of plants have been injured weakly and plants softly survived a transplantation.

For replanting the roots with core mold were taken with diameter of crown not less 1,2-1,5sm.

The best term for transplanting is: spring- April, first half of May, fall- second half of August and all September. The rosette is cut at 1,5-2sm above crown, but so not injury crown bud.

12<sup>th</sup> of August, 2009, 350 roots of *Taraxacum kok-sagyz* were dig out and only 29<sup>th</sup> of August, they were planted. Unfortunately, it had not chance to make an implantation immediately after outplanting and the roots were in freezer with +5°C for long time. Before implantation, the roots were exposed for 12 hours in solution kornevin (new preparation). The establishment was 62 %.

Weak establishment with long term of storage of excavated plants in freezer, late transplantation.

In 2010, the leaves of plants were grew on the beginning of March. Not expecting a flowering, the culling of plants, not containing a caoutchouk was conducted in mid-May. The rubber- containing plants were retransplanted in ground and they were served as basic grafters for collection of seeds, use at many next works.

### 4. The experience on seed propagation of *Taraxacum kok - sagyz*.

The works were conducted in botanic garden of Turkestan, located between sand desert Kyzyl-kum – at south and Karatau mountains – at north, are burg of west Tyan-Shan. The territory is made from chalky sediments, where sand –clay depth of neogene and quaternary alluvium of Syr Darya are located.

**The environmental conditions.** The climate of Turkestan Region is very continental, on moisture conditions has transitional character from very dry to dry submontane. The amount of temperatures is more 10° C and is 4 000-4 600° C.

The average monthly maximum values of air temperatures in July (+28,4° C) and minimum – in January (-5° C). The amount of sediments per year is 204 mm. The big part of sediments falls at cold period of year – from November on March (32 mm), and minimum on August(2 mm)

The winter begins at the second half of December. Often, the first snow falls at the end of December or beginning of January. The duration of days with snow is approximately 45 days, for other years, the sediments fall as rains and the winter passes almost without snow. The characteristics of winter months is permanent rotation of hard frosts and thaws. At the first half of January, on day time air temperature rises up to +10 and +15° C, and for night time bellows up to -5° C.

The spring commences very earl , 15-20<sup>th</sup> of February. From second half of April, air temperature rises up to +25° C, and sometimes up to +30° C.

The summer is hot, with low air moisture and dustiness. The drought season continues for 225 days.

**The soil conditions.** This region is located within limits of sierozemic area. The most characteristic features of sierozemic formation are:

- little thickness of soil layer -20-30 sm,
- ash structure with well apparent aggregate,
- relative poorness of feed elements in plants–nitrogen, phosphorus and microelements.

The soil layer of Turkestan botanic garden is represented by sierozem soils light at pebbly sabulous deposits within limits of alluvial cone of Karatau foot-hills. The parent rock material at many cases are sediments of quaternary, tertiary and upper cretaceous periods. The broods of quaternary period are represented by clay loams.

We show a description of soil pit, located in Turkestan botanic garden, where growing works on taraxacumkok kok sagyz have been conducted:

Line.A-0-22 sm., light- grey, hard clay loam, little cloddy and pulverescent, weakly aggregated, rarely penetrated by roots, transfer is remarkable;

Line.B-22-35 sm., pale-grey, hard clay loam, solid, not-stable cloddy, non-aggregated, transfer is well visible.

Table 1 – Information of grain size analysis of light sierozem soils at pebbly sediments

The depth of sampling, sm	The size of fractions,mm .The contents of fraction, % at absolute dry soil.						
	1-0,25	0,25-0,05	0,05-0,01	0,01-0,005	0,005-0,001	<0,001	<0,01
0-10	0,55	3,53	37,52	13,11	16,49	2,90	58,50
15-25	0,75	12,32	21,77	13,23	15,87	36,07	65,17
35-45	0,53	13,63	16,81	17,55	14,8	36,51	69,04
50-60	0,47	14,82	21,78	14,02	16,47	32,44	62,93
80-90	0,99	27,86	18,92	7,75	12,49	31,99	25,23

Table 2 – Information of chemical analysis of light sierozem soils at pebbly sediments

The depth of sampling, sm	Humus, %	Nitrogen general, %	Total phosphorus, %	Carbon dioxide, %	Movable, phosphorus, mg at 100g of soil
0-10	1,27	0,102	0,078	2,09	0,71
15-25	0,77	0,071	0,085	2,78	0,39
35-45	0,61	0,066	0,084	3,60	0,22

The seeds of plants are very small, absolute weight (thousands of seeds) is 0.453 gr, grow on 4-5 day after seeding and give weak germinant. Already on 45-60 day after seedlings, some species form buds, and after 15 days, they began to flower. Then on 14-16 days after flowering, the ripening of seeds has a place.

The seeds collection of kok-sagyz is expensive. In period of mass flowering and fruiting, which are passed almost at the same time at plantations, the workers on seeds collection walk on same path for 5-6 times per day from 10 a.m. and up to 18 p.m.

Weak sprouts of seeds are unable to break through very light soil caps and only many germinant able to rise soil caps. Therefore, it is recommended to seed in mixture with humus by small knots, in order that sprouts will get a bouquets (10).

Poorly developed vegetative mass of *Taraxacum kok-sagyz* has been not oppressed a weeds, that will complicate a care over plants. Weeds should be weeded by hands.

About emergence of the first shoots and designation of rows crust loosening in row-spacing's on depth of 2-3 cm by choppers manually with destruction of weeds – fingernail clam is immediately made. Thus the loosening of the soil is carried out probably closer to a row but so that not to fill up and to damage shoots

Thus, the cycle of development of plants of the second year of life makes about 95 days. The duration of vegetative period of Turkestan is 220 days. This permit to carry out summer crops of seeds in 20 days of June, and to get second harvest of seeds at the end of September.

##### **5. The recommendations on mass and fast receiving seeds rubber of containing plants of *Taraxacum kok - sagyz*.**

On the basis of extensive references on cultivation *Taraxacum kok-sagyz* and experience of own researches I consider necessary to make the following recommendations about creation of seed base for cultivation of this valuable species of a technical plant.

At introduction in culture of *Taraxacum kok -sagyz*, first of all it is necessary to create the seed fund necessary for development of an industrial plantation of this specie. In the absence of seeds of cultivars collecting a material will be carried out from natural populations of this specie.

As the *Taraxacum kok-sagyz* is very variable look on many morphological signs – a form of a leaf, a basket, it is difficult to distinguish from some other in common growing types of *Taraxacum kok-sagyz*. Therefore, the plants grown up from these seeds are miscellaneous. It reduces overall performance and creates additional difficulties. For creation of pure plantations of rubber of containing plants of *Taraxacum kok-sagyz* it is necessary to adhere to the following scheme of an introduction of *Taraxacum kok-sagyz*.

1. On the basis of a visual assessment from natural populations containing plants are selected rubber, their landing on skilled a site with observance of all requirements is made or reproduction of the selected plants by cutting grafting of roots with the subsequent their landing in soil is made. From these grafters, collecting seeds is made.

2. The seeds collected from grafters are used for propagation method of cultivation of *Taraxacum kok-sagyz*. The seedling grown up in greenhouses and at achievement 6-7 flatter age conditions lands in soil.

3. Collected from these plants (grown up in propagation method) seeds pass after harvest ripening within 10-15 days. Then their summer crops are made and by the beginning of October the second collecting seeds is made.

At cultivation, *Taraxacum kok -sagyz* in conditions with the long period of vegetation (Turkestan) and with application of propagation method of cultivation of plants selected in the first year their cultivation, it is possible to get two harvest of seeds per year.

##### **CONCLUSIONS**

1. *Taraxacum kok -sagyz* is very valuable rubber and inulin containing plant, early cultivated at many countries of CIF, including at south of Kazakhstan in order to get high-quality natural caoutchouk.

2. The perspective of repeated introduction in culture of *Taraxacum kok- sagyz* in the south of Kazakhstan with the long vegetative period where in the years of its cultivation many aspects of agrotechnology were fulfilled is high.

3. The propagation method of cultivation of *Taraxacum kok-sagyz* in the first year of cultivation gives the chance to prolong the vegetative period and to get two harvests of seeds per year.

4. Especially important selection of rubber-bearing forms, receiving seeds from the containing plants selected rubber, vegetative and their mass reproduction

5. Selection of valuable forms of plants in the course of cultivation is an obligatory measure of increase of efficiency and an exit of valuable raw materials – high-quality natural rubber.

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#### БИОМОРФОЛОГИЯ И ПЕРСПЕКТИВЫ ВЫРАЩИВАНИЯ *TARAXACUM KOK-SAGYZ* ROD. В ЮЖНОМ КАЗАХСТАНЕ

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**Ключевые слова:** биоморфология, *Taraxacum kok-sagyz* Rodin, семена собранных с каучук содержащих особей, культивирования.

**Аннотация.** В работе изложены биология развития *Taraxacumkok-caghyz* Rodin., перспективы введения в культуру. В первые годы культивирования вида важное значение придается производству большого объема семян, собранных с каучук содержащих особей. Поэтому рассмотрены пути вегетативного размножения таких растений корневыми черенками, рассадный способ размножения, возможности получения двух урожаев семян в год для решения задач производства большого объема видовой чистых семян

#### *TARAXACUM KOK-SAGYZ* ROD. БИОМОРФОЛОГИЯСЫ, КЕЛЕСЕКТЕ ОНТУСТІК КАЗАҚСТАНДА ӨСІРУ МҮМКІНДІГІ

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**Тірек сөздер:** биоморфологиясы, *Taraxacum kok-sagyz* Rodin, каучікті өсімдіктерден көп мөлшерде ұрық жинау, өсіру.

**Аннотация.** Жұмыста *Taraxacumkok-caghyz* Rodin. даму биологиясы, өсіру мүмкіндігі қаралған. Бұл өсімдік түрін бірінші жыл өсіруде каучікті өсімдіктерден көп мөлшерде ұрық жинау мәселесіне өте үлкен мән беріледі. Сондықтан, сондай өсімдіктерді тамыр кескіндері арқылы көбейту, көшетті жолмен көбейту, жылына екі ұрық өнімін алу мүмкіндігін қарастырып, көп мөлшерде және түр жағынан таза ұрық жинау жолы қаралған.

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