

Ecological and physiological reaction of fibre flax on vegetation

Petr Anatolyevich Kuzmin and Ajgul Muhametnagimovna Sharifullina

Branch of Kazan Federal University, Kazan Str., 89, Elabuga, 423600, Russia

Abstract. Reaction of early ripening and late ripening breeds of fibre flax on vegetation conditions complex was studied in Eastern Predkamie of the Republic of Tatarstan of Russian Federation. Photosynthetic characteristics of breeds have been defined. Breed Lider has been selected by fibre crop capacity and quality of retted stalks inbred testing in the group of early ripening breeds and breeds Orion, Impuls and Lira in the group of mid-season.

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Introduction

Flax is interesting and amazing crop with wide range of valuable features. Demand on flax is high around the world due to wide range of products that are made of it. For example, it is strategic raw materials in Italy and if the USA and Canada a number of projects related to flax are classified. Flax is on the first place as a source of natural ecologically pure products. OOH officially declared flax the crop of XXI century [1,2,3,4,5]. Fibre flax is valuable technical crop of Russia; it is the main domestic source of natural fibre for weaving. To increase gross crop of flax it is necessary to increase area under crop. It is strategic task for Russia. So it is necessary to use all the advantages of breeds' features for a certain region. Local strain test in Russian territory has a special importance [6]. The aim of our research was strain test of fibre flax in Eastern Predkamie of the Republic of Tatarstan to define the most productive.

Climate of the Republic of Tatarstan is temperate continental. Average duration of mild period is 198-209 days and cold period - 157-160 days. Annual precipitation amount is 460-540 mm. Tatarstan territory may be divided into three areas by natural conditions: Predvolzhie (right side of Volga), Predkamie (to the north of Kama), and Zakamie (to the south of Kama). Grey forest soils are most widely spread in Eastern Predkamie [7,8,9].

Method

Research objects are early ripening (Voskhod, Tomski-18, Nord, Dobrynia, Lider) and mid-season (Sinichka, Orion, S-108, Impuls, Lira) breeds of fibre flax. Voskhod and Sinichka were selected respectively in groups of early ripening and mid-season breeds as control breeds. Research was carried out in 2012-2013 in training and experimental vegetable garden of biological faculty of the Institute of Elabuga (branch) of RFU. Vegetation periods in 2012 and 2013 were characterized by higher air

temperature. Average long-term temperature was exceeded by 7 – 11 °C. Precipitation volume was lower than norm.

The experiments had microfield unifactor character with six-fold repeatability and arrangement of variants systematic with shift. Discount area of plot is 1.05 m². Sowing by narrow-row method in the depth 1.5 – 2.0 cm, with a seeding rate 26 million germinating seeds on hectare. Significance of the difference in measures between variants was defined by variance analysis. Content of *a* and *b* chlorophyll, carotenoids in leaves of woody plant was determined by spectrophotometric method (spectrophotometer PA-5400 VI, Russia) in acetone extract (absorption 662, 644 and 440,5 nm, respectively). Pigment concentration was calculated by Holm-Wettstein equations [10]. The soil of experimental plot – grey forest, light loam soil, humus content in soil 2,96 %, phosphorus content 133 mg/kg and potassium content 192 mg/kg, exchange acidity if the soil – neutral.

Main body

According to the research results crop capacity varies by breeds in wide range (see Table 1). Conditions of 2012 and 2013 years provided crop capacity of retted stalks 237 – 399, fibre 72 – 118 and 64 – 82 g/m². The greatest crop capacity in the group of early ripening had the breed Lider (118 g/m²) that is 18 g/m² higher than crop capacity of control breed Voskhod (LSD₀₅ = 14 g/m²) (LSD – least significant difference). Breeds Lider and Nord were leading in seed crop capacity (11 – 13 g/m² higher) comparing crop capacity in control group (LSD₀₅ = 8 g/m²). Flax productivity results of the breed Dobrynia was lower than results of all breeds in this group. Fibre crop capacity of breeds Nord and Tomski 18 was 105 – 109 g/m². Fibre flax breeds Orion, Impuls and Lira provided significant fibre crop capacity increase (12 – 17 g/m²) in the group of mid-season comparing with

crop productivity S-108. There was no significant difference in this group by seed crop productivity.

Table 1. Crop productivity of different breeds of fibre flax, g/m²

Breed	Retted stalks	Fibre	Seeds
Voskhod (c)	337	100	69
Tomski 18	339	105	72
Nord	350	109	82
Dobrynia	237	72	64
Lider	369	118	80
Sinichka (c)	361	106	79
Orion	399	116	75
S-108	342	99	74
Impuls	397	111	71
Lira	369	111	77
LSD ₀₅	36	14	8

Differences in crop capacity of tested breeds are caused by changes of its structure (see Table 2). Fibre and seeds crop productivity increase of the breed Lider was achieved due to greater survival rate (19%) under LSD₀₅ = 5 and thickness of productive density by 274 un./m² under LSD₀₅ = 84, in comparison with crop productivity of the breed Voskhod.

Table 2. Crop capacity of different breeds of fiber flax

Breed	Field germination rate, %	Survival rate, %	Thickness of productive density, un./m ²	Mass of 1000 seeds, g
Voskhod (c)	86	58	1292	4.3
Tomski 18	82	68	1458	3.5
Nord	69	86	1554	3.4
Dobrynia	77	68	1353	3.3
Lider	78	77	1566	4.4
Sinichka (c)	78	78	1585	4.3
Orion	83	78	1672	3.6
S-108	77	70	1392	3.7
Impuls	79	66	1369	3.4
Lira	75	75	1468	3.5
LSD ₀₅	3	5	84	0.8

Breeds Voskhod and Lider were better in the mass of 1000 seeds (4.3 – 4.4 g), but Voskhod has lower survival rate (58%) and thickness of productive density – 1292 un./m², so this breed is lower in fibre and seeds crop productivity than Lider. In the group of mid-season breeds fibre and seeds crop capacity increase of Orion was achieved due to greater field germination rate (5%) under LSD₀₅ = 3 and under greater thickness of productive density on 187 un./m² under LSD₀₅ = 84 comparing the breed Sinichka.

Conditions of 2012 year affected technological measures of flax retted stalks quality. Grab length had changed in the limits of 73 – 84 cm with fibre content 28 – 32 %. The bigger fibre content

of the breed Lider is 32 %, that is 2% higher that this measure of control breed Voskhod under LSD₀₅ = 2 %. Nord, Dobrynia and Lider were better in the group of early ripening breeds by resistance of fibre that was greater on 5, 7 and 9 kgf, respectively, that the same measure of Voskhod under LSD₀₅ = 2 kgf. Resistance of retted stalks of Lira breed in the group of mid-season breeds was 2 kgf higher than those of Sinichka.

Table 3. Technological indicators of flax retted stalks quality depending on the breed

Breed	Grab length, cm	Fibre content, %	Resistance, kgf	Retted stalks score
Voskhod (c)	84	30	14	1,81
Tomski 18	81	31	14	1,81
Nord	73	31	19	2,00
Dobrynia	77	30	22	2,25
Lider	73	32	23	2,38
Sinichka (c)	76	30	18	1,94
Orion	77	29	15	1,69
S-108	70	29	19	1,88
Impuls	84	28	19	1,88
Lira	73	30	20	1,94
LSD ₀₅	4	2	2	0,37

Breeds Dobrynia and Lider had the greatest retted stalks score in the group of early ripening breeds and was 2.25 and 2.38 score that was 0.44 and 0.57 greater that retted stalks score of Voskhod breed. In the group of mid-season breeds these was no significant difference in analyzed breeds.

Photosynthetic pigments content in fibre flax leaves is shown in Table 4. In all breeds of the group of early ripening breeds *a* chlorophyll content in leaves was 0.61 – 1.63 mg/g of dry matter higher that those of control breed Voskhod (2,21) under LSD₀₅=0,41 mg/g of dry matter. The greatest *a* chlorophyll content was observed in the group of early ripening breeds with Nord (3.84), that is 0.42 – 1.02 mg/g of dry matter higher comparing with this measure of the other breed of this group and with S-108 in the group of mid-season breeds (2.65), that was 0.53 mg/g of dry matter higher than the same measure of Orion.

Table 4. Photosynthetic pigments content in budding phase of fibre flax, mg/g of dry matter

Breed	<i>a</i> chlorophyll	<i>b</i> chlorophyll	Carotenoids
Voskhod (c)	2.21	0.70	1.18
Tomski 18	3.42	1.42	2.41
Nord	3.84	1.82	2.65
Dobrynia	3.22	1.25	2.24
Lider	2.82	1.92	2.60
Sinichka (c)	2.51	2.32	2.51
Orion	2.12	1.92	2.56
S-108	2.65	1.80	2.57
Impuls	2.33	2.09	2.54
Lira	2.44	2.25	2.54
LSD ₀₅	0.41	0.32	0.02

B chlorophyll content in leaves of all early ripening breeds of fibre flax was 0.55 – 1.22 mg/g of dry matter higher than this measure in control breed (0.70) under $LSD_{05}=0.32$ mg/g of dry matter. Greater content of carotenoids was observed with studied breeds of early ripening and mid-season groups – 1.06 – 1.47 and 0.03 – 0.06 mg/g of dry matter, respectively, that with plants of control breed under $LSD_{05}=0.02$ mg/g of dry matter.

Conclusion

Natural and climate conditions of Eastern Predkamie of the Republic of Tatarstan are favorable for cultivating fibre flax. Efforts on definition of the most productive breeds of fibre flax are urgent and have great economic value for the region. Considering ecological effect inhabitants of this territory receive high quality raw materials: fibre and linseed-oil. We have shown ecological and physiological reaction of early ripening and late ripening breeds on the complex of abiotic conditions. We have determined crop capacity of breeds, grounded it by the structure and define pigment content in leaves that may help to define the breed for cultivating in future.

Resume

Breed Lider was better by crop capacity of fibre comparing control breed and Lider and Nord were better by seeds crop capacity. Orion, Impuls and Lira were better by fibre crop capacity in the group of mid-season breeds. But these breeds of analyzed groups provided different quality of retted stalks. Lider was better by this measure (2.38 score).

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Corresponding Author:

Dr.Kuzmin Petr Anatolyevich

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Branch of Kazan Federal University
Kazan Str., 89, Elabuga, 423600, Russia

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