



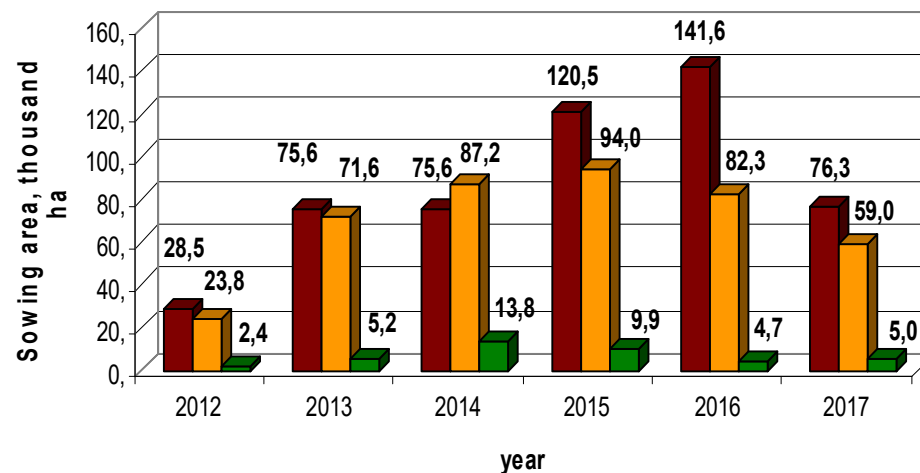
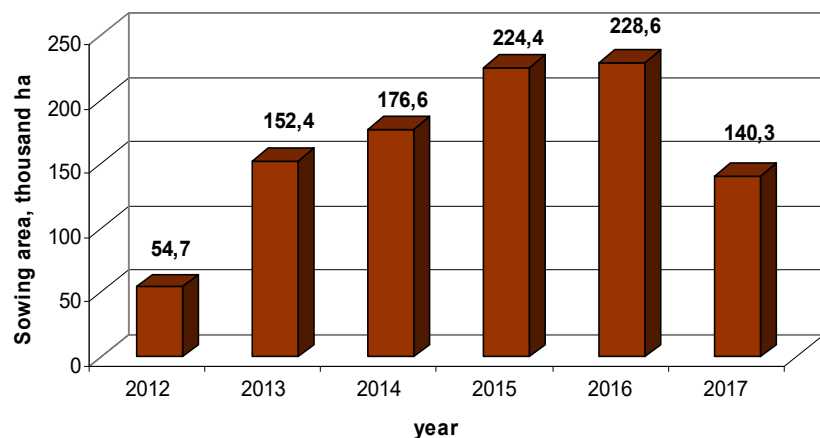
## *Sorghum: the safe bet for the future*

### **Genetic diversity of sorghum in Russia**

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State Scientific Establishment "Agricultural Research Center "Donskoy"

# The sowing area of sorghum in Russia



■ PreVolzhsky Federal District ■ Southern Federal District ■ Other

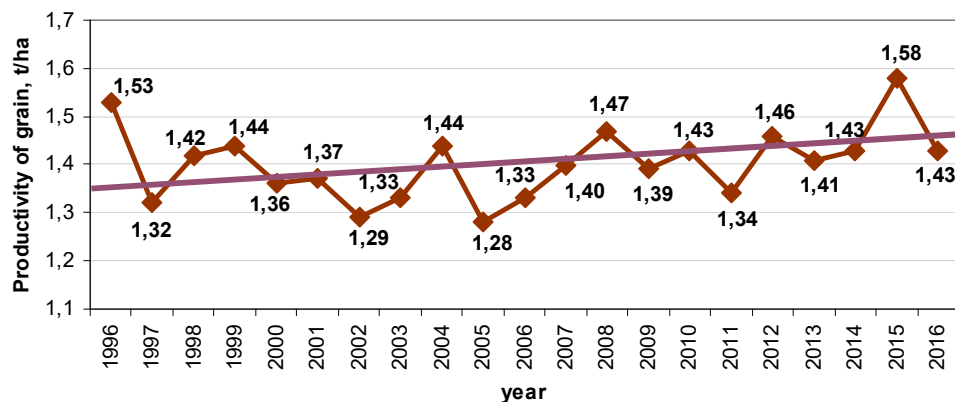
## Area of arable land

- Russia – 123 m ha
- Southern Federal District (4) – 22.8 m ha
- PreVolzhsky Federal District (3) – 37.4 m ha

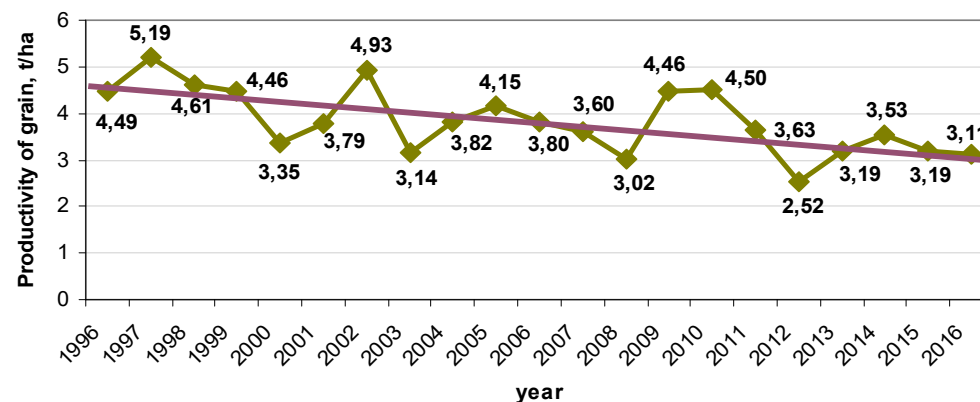


# Productivity of grain sorghum in Russia (source: FAOSTAT)

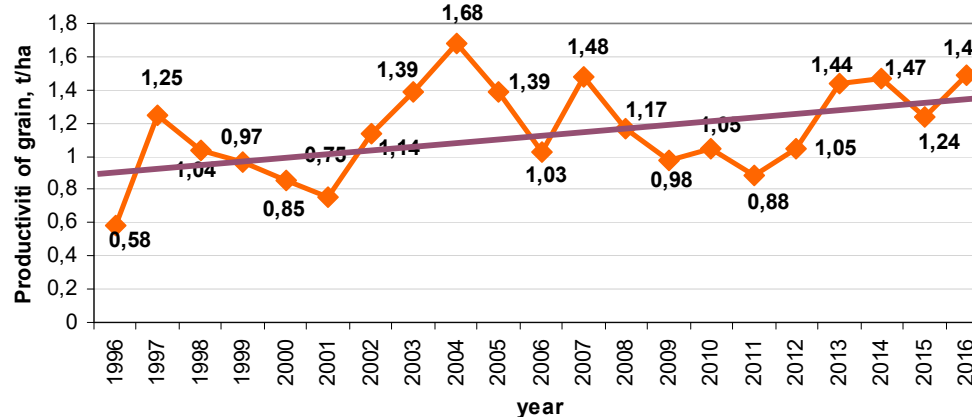
*Productivity of grain sorghum in the world*



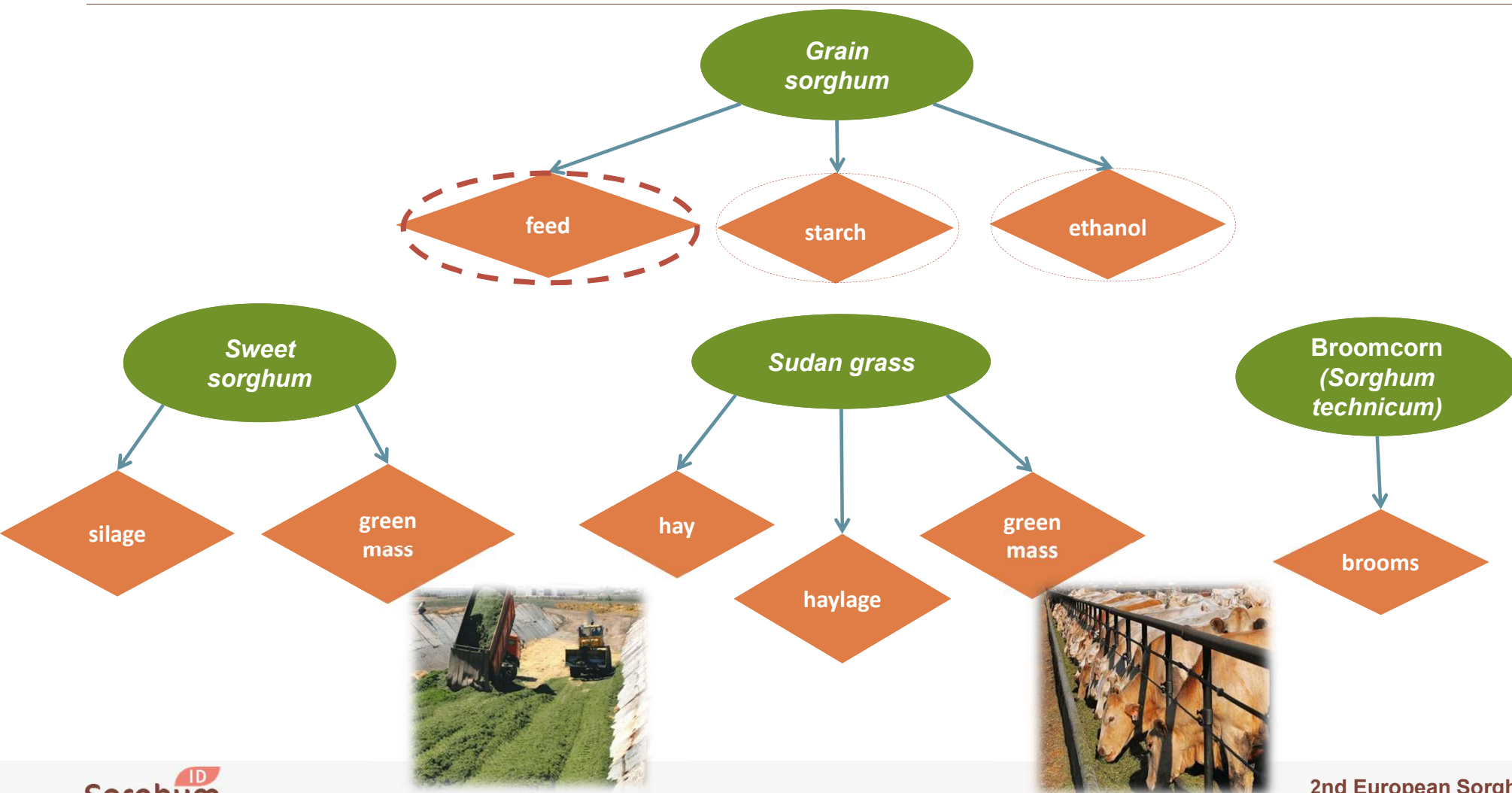
*Productivity of grain sorghum in Europe*



*Productivity of grain sorghum in Russia*

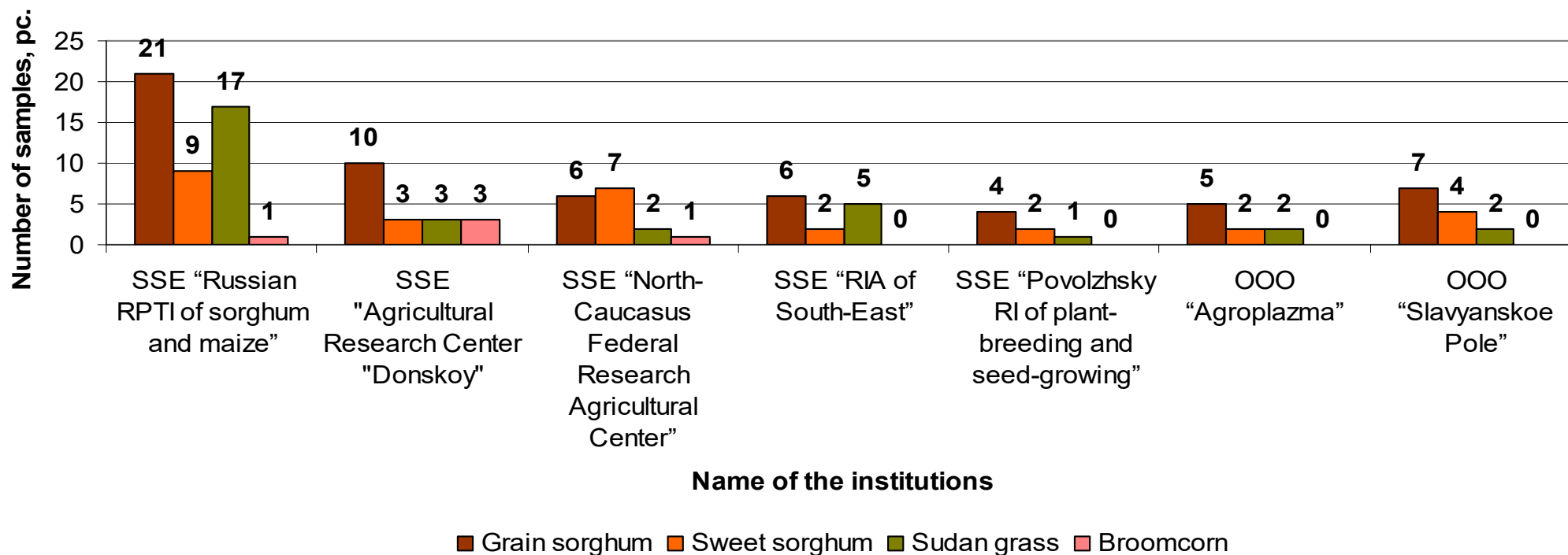


# The use of sorghum in Russia



# The main establishments of sorghum breeding in Russia

	Grain sorghum	Sweet sorghum	Sudan grass	Broomcorn
A number of sorghum varieties and hybrids in the State List of RF, pc	109	47	71	13





*N.I. Vavilov*

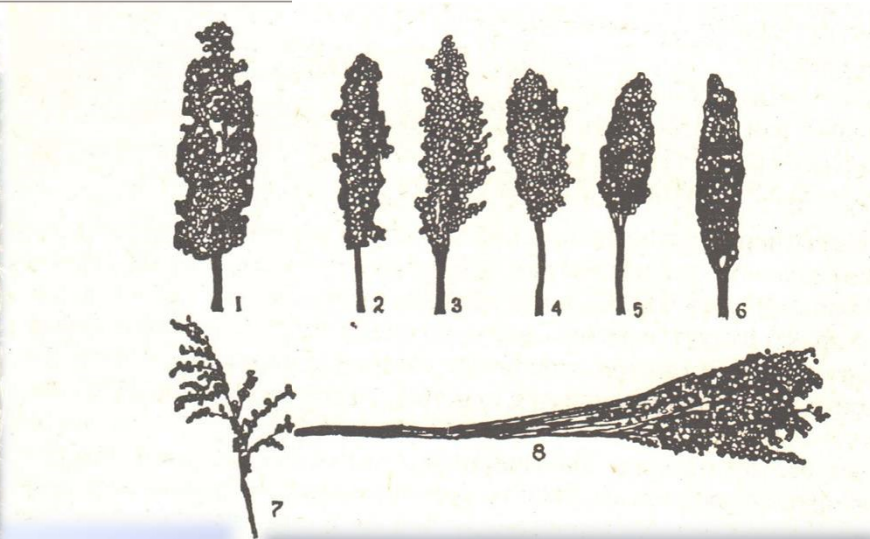
## *The Kuban experimental station*

- The station was established by the initiative of N.I. Vavilov in 1924. It is located in the steppe part of the North Caucasus (the Krasnodar Area). The station is the main center of study and maintenance of the genepool of maize, sorghum, grain crops, legumes, technical and forage crops. The station has the State Seed Storage, where 350 thousand samples can be stored under the temperature from +4°C till -18°C.



	<b>Grain sorghum</b>	<b>Sweet sorghum</b>	<b>Sudan grass</b>
<b>A number of samples, pc</b>	<b>5987</b>	<b>420</b>	<b>347</b>

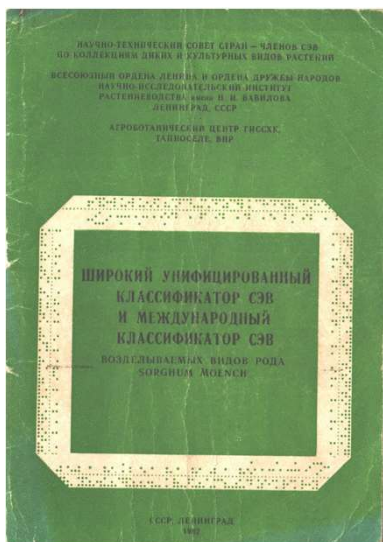
# Sorghum classification



## *Sorghum classification* (according to E.S. Yakushevsky, 1967)

1. *S. guineense*
2. *S. caffrorum*
3. *S. bantuorum*
4. *S. durra*
5. *S. chinense*
6. *S. saccharatum* (*effusum*, *contractum*)
7. *S. sudanense*
8. *S. technicus*

# Descriptors of the cultivating species of SORGHUM MOENCH



## *Inflorescence – length (cm, points)*

	For grain sorghum	For broomcorn
1 – very short	<10 cm	<30 cm
3 – short	10-20 cm	30-40 cm
5 – intermediate	21-30 cm	41-50 cm
7 – long	31-40 cm	51-60 cm
9 – very long	>40 cm	>60 cm

## *1000-kernel weight (g, points)*

1 – very small (<15 g)
3 – small (15-20 g)
5 – intermediate (21-30 g)
7 – large (31-40 g)
9 – large (>40 g)

## *Content of raw protein in kernels (% , points)*

1 – very low (<8%)
3 – low (8,0-10,5%)
5 – intermediate (10,6-13,0%)
7 – high (13,1-15,5%)
9 – very high (>15,5%)

## *Degree of stem lodging (% , points)*

1 – very low (<5%)
3 – low (5-10%)
5 – intermediate (11-25%)
7 – high (26-50%)
9 – very high (>50%)

## *Scale of disease infection (% , points)*

1 – very low (<5%)
3 – low (5-20%)
5 – intermediate (21-35%)
7 – high (36-50%)
9 – very high (>50%)

## *Sugar content in a stem (% , points)*

1 – very low (<8%)
3 – low (8,0-11,0%)
5 – intermediate (11,1-15,0%)
7 – high (15,1-19,0%)
9 – very high (>19,0%)

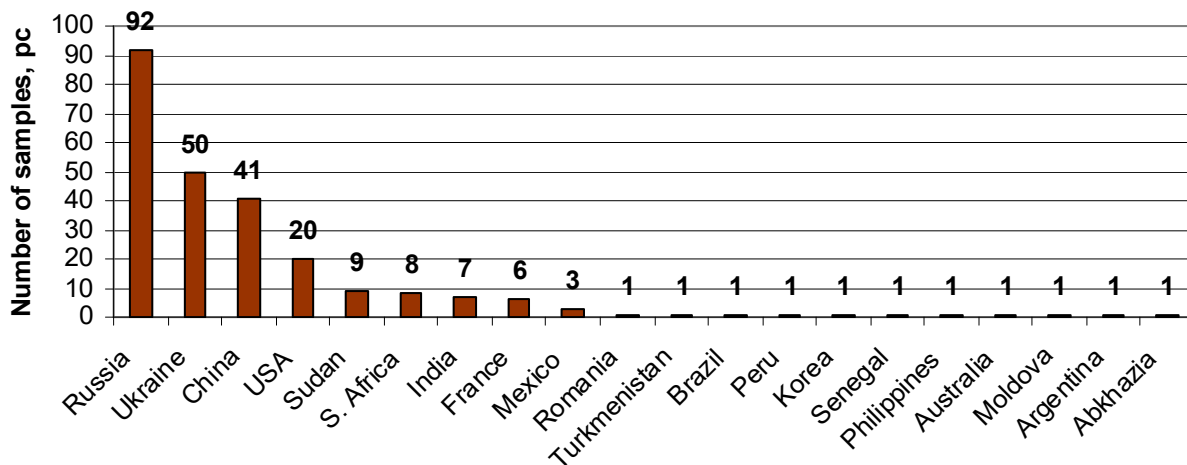
## *Vigor of initial growth (up to 30 days)*

1 – very low (<30 cm)
3 – low (30-45 cm)
5 – intermediate (46-60 cm)
7 – high (61-75 cm)
9 – very high (>75 cm)



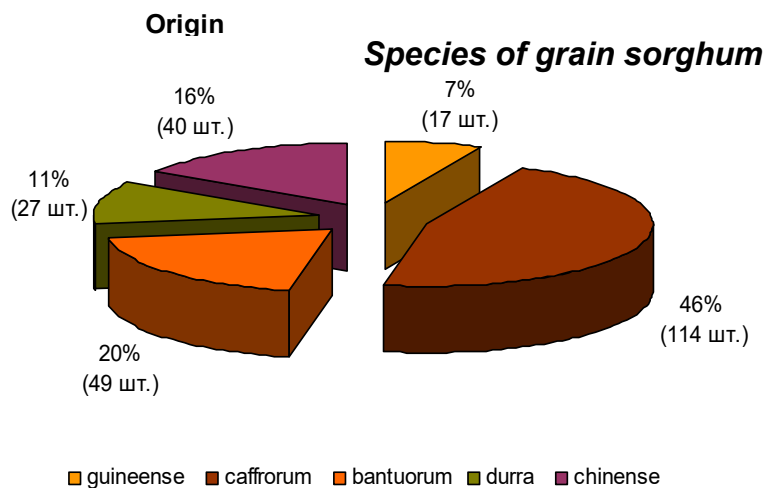
# The study of the collection samples of grain sorghum in the SSE “ARC “Donskoy”

**Grain sorghum origin**



**The studied traits**

- Period 'sprouts-complete ripeness' (82-123 days)
- Plant height (67-224 cm)
- Length of a peduncle (0-30 cm)
- Number of kernels per panicle (546-3471 pc)
- 1000-kernel weight (13.7-43.0 g)
- Grain productivity (156-742 g/m<sup>2</sup>)
- Grain quality:
  - protein (8.1-15.6%)
  - starch (69.5-78.2%)
  - oil (2.4-6.4%)
  - ash (1.0-2.3%)
  - fiber (1.3-2.4%)
  - tannin (0.28-5.56%)
- Resistance to lodging (1-7 points)



# Grain sorghum varieties developed by the SSE "ARC "Donskoy"



*Zernogradskoe 53*



*Luchistoe*



*Orlovskoe*



*Khazine 28*



*Velikan*



*Zernogradskoe 88*



*Ataman*

## Biochemical composition of sorghum grain

Variety	Contents, %					
	protein	starch	oil	ash	fiber	tannin
Khazine 28	12.2	74.6	2.93	1.08	2.11	0.93
Zernogradskoe 53	12.1	74.2	2.73	1.42	2.12	2.93
Luchistoe	11.5	75.1	2.60	1.20	2.08	0.99
Orlovskoe	11.8	74.7	3.20	1.20	2.12	2.11
Zernogradskoe 88	12.1	75.2	3.88	1.13	2.06	0.88
Velikan	11.9	75.1	3.90	1.02	2.08	0.46
Ataman	11.4	76.2	3.50	1.57	2.14	0.57
Average	12.0	74.8	3.21	1.18	2.10	1.02

## Starch yield from sorghum grain



The name of the variety/hybrid	Color of kernels	Starch content, %	Yield of products, %			
			starch	fiber	extract	processing water
Zernogradsky 282 MV (maize)		72.5	63.0	14.0	6.6	3.6
Khazine 28	white	80.5	65.9	12.6	5.2	2.4
Zernogradskoe 53	red	78.5	64.2	13.4	4.6	3.9
Luchistoe	pink	76.3	67.7	11.8	5.2	2.3
Orlovskoe	red	76.4	64.6	12.9	4.8	4.2
Zernogradskoe 88	white	76.7	64.8	13.2	4.5	3.8
Velikan	white	75.7	63.6	12.4	5.5	4.6
Ataman	white	77.9	66.7	13.5	4.9	2.1

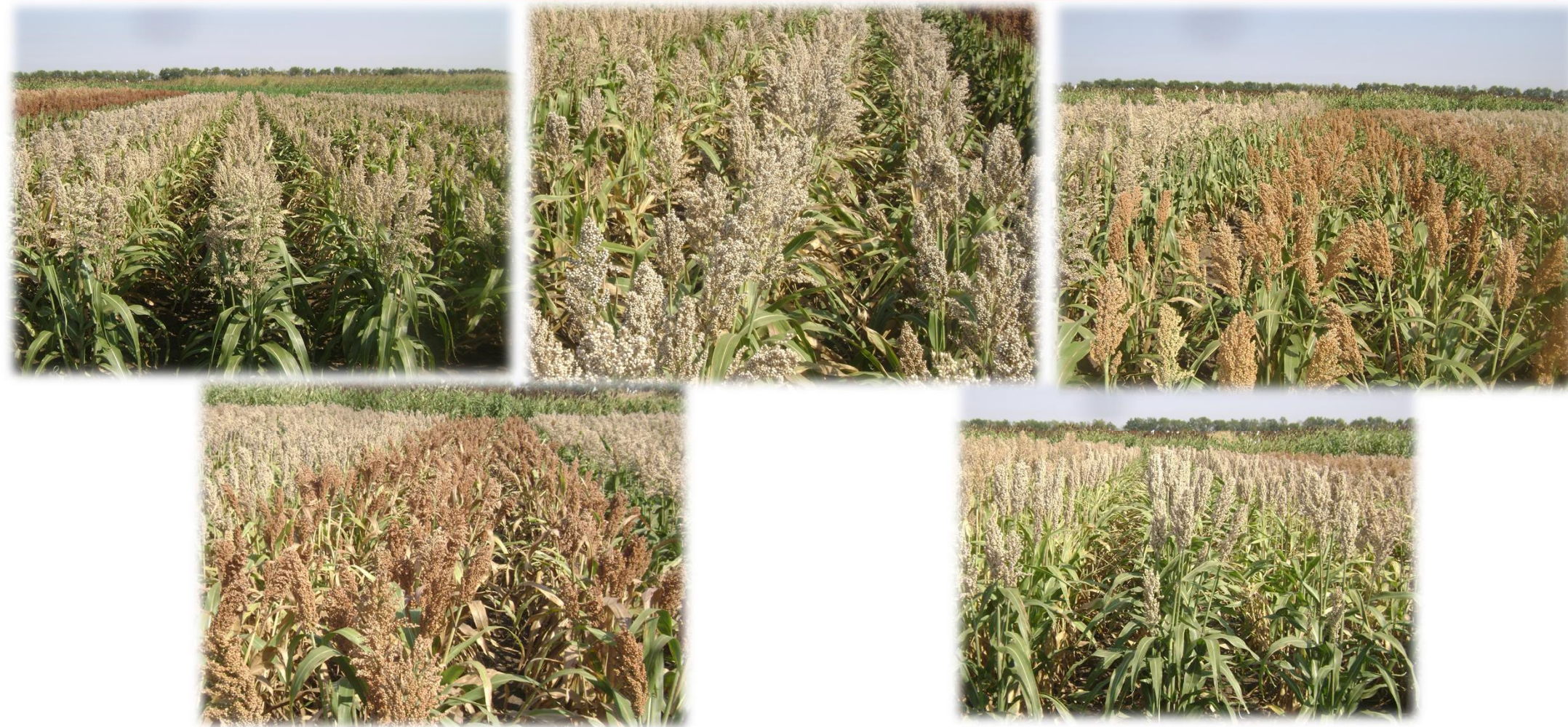
- The study results obtained by the FSBSI ARRI of starch products

## The use of grain sorghum for ethanol production



Variety	Ethanol yield, daL/t
Khazine 28	63.82
Velikan	63.84
Luchistoe	64.28
Zernogradskoe 88	64.36
Wheat	64.42 – 65.57
Triticale	63.60 – 65.53

# The new lines of grain sorghum



# The development of hybrids on a sterile basis

*CMS-line Demetra*



*CMS-line Dgetta*



# Cold resistance of grain sorghum varieties and lines

№	Variety/line	Color of kernels	2016-2017 year	
			Cold resistance, %	Group of cold resistance
1	ZSK 6/17	pink	98.4	I – high resistance
2	Lazurit 601/16	yellow	98.3	I – high resistance
3	ZSK 427/10	pink	97.4	I – high resistance
4	ZSK 540/15	white	97.2	I – high resistance
5	ZSK 420/16	white	94.5	I – high resistance
6	ZSK 445/16	yellow	94.1	I – high resistance
7	ZSK 117/6	pink	92.3	I – high resistance
8	ZSK 600/15	pink	88.3	I – high resistance
9	ZSK 444/16	white	87.3	I – high resistance
10	Zernogradskoe 88/4	white	87.1	I – high resistance
11	Luchistoe	pink	86.5	I – high resistance
12	ZSK 173/16	pink	86.2	I – high resistance
13	Orlovskoe	red	85.5	I – high resistance
14	Zernogradskoe 204/4	white	77.1	II – above average resistance
15	Zernogradskoe 53	red	76.0	II – above average resistance
16	Khazine 28	white	75.9	II – above average resistance
17	ZSK 34/15	yellow	67.7	II – above average resistance

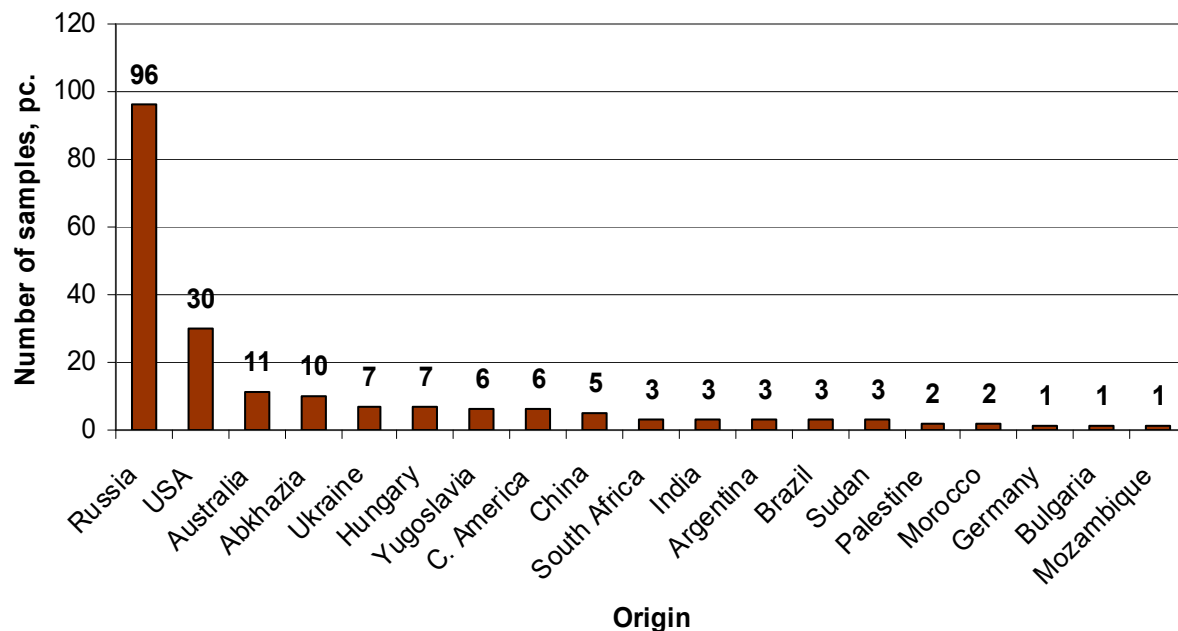
Control:  
t=27-28°C (7 days)

Experiment:  
t=7-8°C (15 days) +  
t=27-28°C (4 days)



# The study of collection samples of sweet sorghum in the SSE “ARC “Donskoy”

**Sweet sorghum origin**



## *The studied traits*

- Period 'sprouts-complete ripeness'(92-139 days)
- Plant height (67-224 cm)
- Foliage formation (15-45%)
- Sugar content in sap (3-25%)
- Productivity of green biomass for silage (980-5968 g/m<sup>2</sup>)
- Quality of green mass:
  - Content of absolutely dry matter (25-41%),
  - Protein (5.1-8.5%)
  - Oil (1.8-3.0%)
  - Ash (4.8-7.0%)
  - Fiber (38.0-41.5%)
- Resistance to lodging (1-9 points)

# The sweet sorghum varieties developed by the SSE “ARC “Donskoy”



***Zernogradsky yantar***

- Early-ripening (‘germs-milky-wax maturity’ 98-100 days)
- Plant height – 180-190 cm
- Sugar content in sap – 13-14%
- Productivity of green mass for silage – 36-39 t/ha



***Debyut***

- Early-ripening (‘germs-milky-wax maturity’- 95-98 days)
- Plant height – 185-200 cm
- Sugar content in sap – 14-16%
- Productivity of green mass for silage – 36-40 t/ha

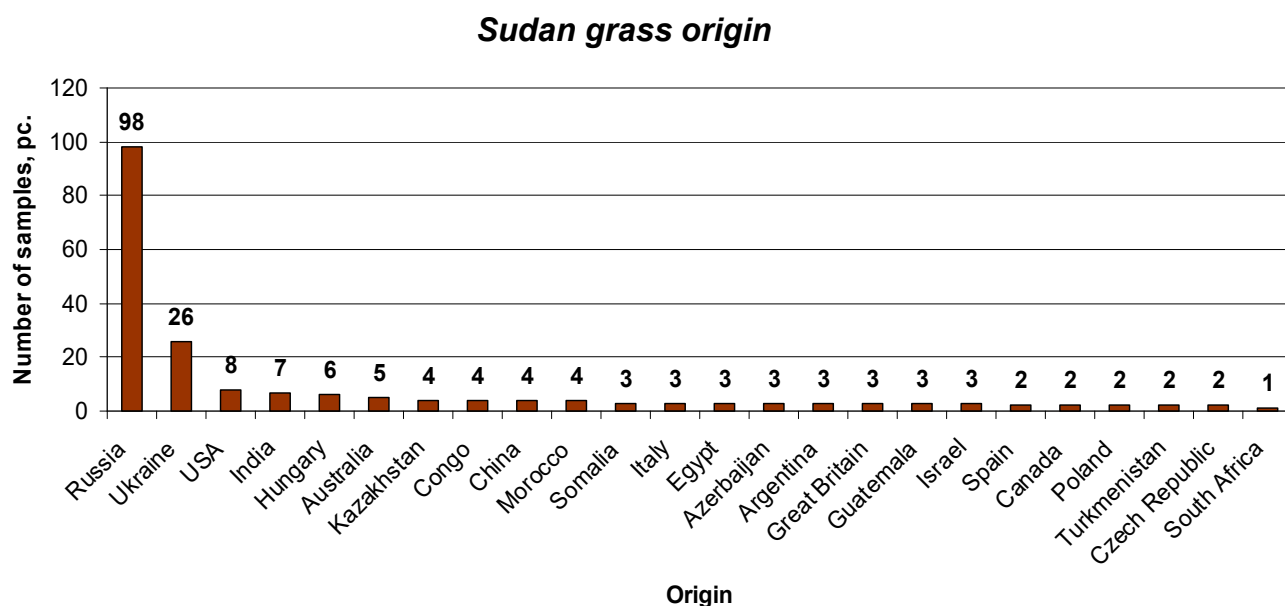


***Listvenit***

- Middle-ripening (‘germs-milky-wax maturity’- 105-110 days)
- Plant height – 170-185 cm
- Sugar content in sap – 8-11%
- Productivity of green mass for silage – 44-46 t/ha

# The study of collection samples of Sudan grass in the SSE “ARC “Donskoy”

## The studied traits



- Period 'germs-paniculation' (35-70 days)
- Plant height (150-300 cm)
- Intensity of initial growth and after cutting growth (1-9 points)
- Stem diameter (0.2-1.5 cm)
- Foliage formation (12-43%)
- Tilling capacity (1-8 stems per plant)
- Green biomass productivity (440-5000 g/m<sup>2</sup> per two cuttings)
- Green mass quality:
  - Content of absolutely dry matter (12.8-30.0%)
  - Protein (4.8-14.4%)
  - Oil (1.0-3.8%)
  - Ash (3.0-14.3%)
  - Fiber (28.7-43.6%)
- Resistance to lodging (1-9 points)

# The varieties and hybrids of Sudan grass developed in the SSE “ARC “Donskoy”



***Aleksandrina***

- Middle-ripening (‘germs-paniculation – 45-50 days, ‘germs-complete ripeness – 95-100 days)
- Tilling capacity – 4-5 stems
- Foliage formation – 40-45%
- Green mass productivity – 35-40 t/ha



***Anastasiya***

- Middle-ripening (‘germs-paniculation – 48-55 days, ‘germs-complete ripeness – 98-100 days)
- Tilling capacity – 4-6 stems
- Foliage formation – 40-45%
- Green mass productivity – 37-43 t/ha



***F1 Gustolistny***

- Middle-ripening (‘germs-paniculation – 55-60 days, ‘germs-complete ripeness – 100-105 days)
- Tilling capacity – 4-5 stems
- Foliage formation – 40-46%
- Green mass productivity – 42-48 t/ha

# The varieties of broomcorn developed in the SSE “ARC “Donskoy”



**Zernogradskoe 38**

- Middle-ripening ('germs-complete ripeness' – 105-110 days)
- Plant height – 160-180 cm
- Broom yield – 4.5-4.8 thousand pc per hectare



**Artem**

- Early-ripening ('germs-complete ripeness' – 95-98 days)
- Plant height – 150-160 cm
- Broom yield – 3.8-4.0 thousand pc per hectare



**Venskor**

- Early-ripening ('germs-complete ripeness' – 97-100 days)
- Plant height – 165-175 cm
- Broom yield – 4.0-4.2 thousand pc per hectare



## Cooperation with SSE “ARC “Donskoy”



- Exchange of breeding material (varieties which were introduced into the State List)
- Joint research
- Joint publication of research papers
- Employee internships

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