resistant. The experimental evidence indicates that the resistance genes of the parental forms are located on homologous chromosomes, but we have not identified them or determined their allelism. The question that remains unanswered is why the F_2 hybrid population of '*Lr24* / Nemchinovskaya 24' segregated for resistance to leaf rust, whereas the cross 'Nemchinovskaya 24 / *Lr24 + Sr24*' produced no susceptible plants in the F_2.

Septoria sp. fungi affect all wheats to one extent or another. No fully disease-resistant wheat is known in the world collection. Plants with relative resistance are sensitive to the pathogen at later developmental stages. One example is the Bulgarian winter wheat PI476772 from the Moscow International Science and Technology Center's collection. The line also is resistant to leaf rust and highly resistant to mildew. Hybrid progenies from crossing this line with Nemchinovskaya 24 also are resistant to leaf rust (% infection in both F_1 and F_2 = 0), and *Septoria* develops late on them. According to preliminary data obtained by our laboratory, this Bulgarian wheat has the genotype *Lr10*, *Lr26*, and *Lr46*.

Nemchinovskaya 24 soft winter wheat is resistant to leaf rust. It will be necessary to identify the resistance genes. Using hybrid populations, which are not susceptible to leaf rust and not segregating for resistance, in soft wheat selection for resistance to leaf rust can be effective.

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The evaluation of spring bread wheat cultivars, NILs, and promising lines to leaf, stem, and stripe rusts in 2008.

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In 2008, during the vegetative period of spring bread wheat, leaf, stem, and stripe rusts epidemics were observed and evaluated. The severities of these diseases were different. Leaf rust was estimated as moderate. Atem and stripe rusts were observed as weak. Evaluation of a set NILs carrying *Lr* genes show that the severity of the leaf rust epidemic on susceptible cultivars was 50–55%. Highly resistant lines (IT = 0;1) had the genes *Lr9*, *Lr28*, and *Lr29* and gene combinations *Lr9+Lr19, Lr19+Lr24, Lr19+Lr25, and Lr19+Lr26*. Interestingly, genes *Lr28* and *Lr29* showed an IT = 0;1, but several years ago (2000) these genes had an IT = 3. Hence, within eight years sharp changes in the set of pathotypes has taken place, enablling *Lr28* and *Lr29* to be highly effective.

The evaluation of promising spring bread wheat lines to stem and stripe rusts was made in the southwest part of the Saratov region. An IT = 0 in the NILs and promising lines had the following combinations of *Sr* genes: *Sr24+Sr25* and *Sr25+Sr31*. The majority of spring bread wheat sowings in this zone include the cultivars L503, L505, Belyanka and Dobrynya. The cultivars L503, L505, and Dobrynya had ITs = 0; Belyanka had an IT of 3. Resistance to stripe rust in the L503, L50,5 and Dobrynya controlled by an unindentified *Yr* gene(s). This *Yr* gene(s) was transmited from the above-mentioned cultivars into the promising lines.

Agronomic performance of multilinear mixes on the basis of spring bread wheat cultivar Dobrynya.

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The perceived advantages of mixtures over their components in monoculture include larger yields, more stable performance, and improved and more durable resistance to diseases. In 2008, we investigated multilinear mixes on the basis of cultivar Dobrynya. These mixes include four components: Dobrynya, Dobrynya *Lr19+Lr9*, Dobrynya *Lr19+Lr24*, Dobrynya *Lr19+Lr25*, and all components in equal parts. We also used mixtures of the first (prepared in 2008) and second years (after cultivation in 2007). The control used all lines and Dobrynya. We looked at the agronomical traits heading date, plant height, resistance to lodging, 1,000-kernel weight, and grain productivity. For heading date, the multilinear mixes did not differ from lines or cultivar. For plant height, the component liness did not significantly differ among themselves however, Dobrynya *Lr19+Lr24* was greater on average. Multilinear mixes did not significantly differ for platn height from the component average, but mixes of the first and the second year cultivation were higher than the components, averaging 5–6 cm. For lodging resistance, we observed that the first-year mix was more resistant than the component liness, but the second-year mix was not significantly lower. For 1,000-kernel weight, significance was not observed, but the first-year mix was higher than that of the second-year mix and lower than component average. For grain productivity, the first-year mix was not significantly different from component average, although an increase in productivity was 10%. The second-year mix was significantly higher than the component average at 26%. We are now analyzing pustule number for leaf rust on a susceptible component mixture, spike productivity, flour quality of components and mixes.

Influence on disease resistance of translocations from Thinopyrum intermedium; Th. elongatum; Secale cereale; T. turgidum subsps. durum, dicoccoides, and dicoccum; and T. timopheevii subsp. timopheevii in spring bread wheat lines.

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For four years (2005–08), spring bread wheat lines carrying translocations from *Th. intermedium; Th. elongatum; S. cereale*; *T. turgidum* subsps. *durum, dicoccum,* and *dicoccoides;* and *T. timopheevii* subsp. *timopheevii* were investigated for resistance to some diseases (Table 1). A combination of alien chromatin from several species in one genotype significantly improves disease resistance in these lines. The spring bread wheat line L2772, with chromatin from both *Th. intermedium* and *T. turgidum* subsp. *durum* has race-specific resistance to a loose smut and resistance to leaf rust, powdery mildew, and common bunt in comparison with the parental lines. Similar results have been obtained for line L2816 with *Th. elongatum* and *T. turgidum* subsp. *durum* chromatin. Line L2780, which combains chromatin from *Th. elongatum* and *T. timopheevii* subsp. *timopheevii* was nearly resistant to loose smut, leaf rust, and powdery mildew and

Table 1. The infection type (IT) of spring bread wheat lines to leaf rust, powdery mildew, loose smut, and common bunt.

Line	Pedigree	Leaf rust	Powdery mildew	Pathotypes: Loose smut 505	Loose smut 164	Loose smut 36	Common bunt 894	Common bunt Tul 5
Donor species – *Thinopyrum elongatum*								
L3065	Saratovskaya 55/*Th. elongatum**3/ Saratovskaya 29	3	2	8.8	26.3	24.0	0.0	—
Donor species – *Triticum turgidum* subsp. *dicoccoides*								
L215	Saratovskaya 55*4/*T. turgidum* subsp. *dicoccoides*	0	0	28.8	21.5	65.0	20.0	17.0
Donor species – *Triticum turgidum* subsp. *dicoccum*								
L196	S58/*T. turgidum* subsp. *dicoccum**3// S58	1	2	70.0	66.8	51.1	5.7	5.2
Donor species – *Triticum timopheevii* subsp. *timopheevii*								
L2780	CI-12633/Л504	0	0	0.0	0.0	0.0	25.1	30.0
Donor species – *Triticum turgidum* subsp. *durum*								
L2816	Л528/Saratov. golden	0	0	6.3	4.7	16.7	5.4	13.8
Donor species – *Triticum turgidum* subsp. *dicoccum* + *Th. elongatum*								
L2358	L401/*T. turgidum* subsp. *dicoccum*/ L401/S55/L2033/S60/Prohorovka	0	0	0.0	0.0	0.0	7.3	9.0
Donor species – *Triticum turgidum* subsp. *durum* + *Secale cereale*								
L3630	L2040/Prohorovka	2	1	5.5	4.5	2.1	—	—
L805	L2040/Lut.13-80	0	2	4.8	8.5	1.3	—	—
Donor species – *Triticum turgidum* subsp. *durum* + *Th. intermedium*								
L2772	L164/L222	0	1	13.3	35.8	0.0	0.0	—

had a low level of a infection by common bunt. Resistance to a complex of diseases was shown line L2358, with *T. turgidum* subsp. *dicoccum* and *Th. elongatum* chromatin.

Of particular interest is L3065, which contains a chromatin from *Th. elongatum*. This line shows race-specific resistance to loose smut and pathotypes of common bunt but is susceptible to leaf rust and powdery mildew. Line L215, which was produced from crosses with *T. turgidum* subsp. *dicoccoides,* has resistance to leaf rust and powdery mildew, moderate resistance to common bunt, and race-specific resistance to loose smut. Small lesions from leaf rust and common bunt were shown line L196, which has chromatin from *T. turgidum* subsp. *dicoccum*, but is susceptible to the pathotypes of loose smut investigated here.

A combination in one genotype of alien genes with own genes from *T. aestivum* gives a positive effect. Thus, lines L3630 and L805, which include line L2040 in their pedigree (contains chromatin from *T. turgidum* subsp. *durum*), have shown a high level of resistance to the pathotypes of loose smut investigated, and they also have tolerance to leaf rust and powdery mildew.

These data show that combining several alien genes (chromatins) in one bread wheat genotype can produce lines with complex diseases resistance or lower the degree of damage.

Effects of an Lr26 translocation on grain productivity and grain protein content in spring bread wheat.

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The first fertile hybrids between wheat and rye were received in Saratov in 1918. However, the using the desirable genetic material from the rye genepool for improvement of spring wheat has been limited by undesirable linkages in the rye translocations, in particular with genes that decrease grain quality. At ARISER, based on the best Saratov-bred spring bread wheat cultivars, a set of NILs with the *Lr26* translocation were produced. The donors of the translocation with *Lr26* were Genaro 81 and an NIL of Thatcher. The Saratov population of leaf rust included virulent pathotypes to *Lr26* and *Lr19*. The combination of translocations with *Lr26* from *S. cereale* and *Lr19* from *Th. elongatum* is effective against the Saratov population of *P. triticina*. Under leaf rust epidemics in 2004 and 2005, this combination of translocations positively effected grain productivity (t/ha), grain protein content (%), and grain protein yield (t/ha). In the hard drought conditions of 2007, grain productivity and grain protein content of lines containing a combination of *Lr19* + *Lr26* did not significantly differ from the checks with only one translocation (*Lr19* or *Lr26*). The 6-year average of lines L706-02 and L785-02 (L503*5/Tc *Lr26*) compared with L503 were 0.20 and 0.41% for grain protein content and 12.9 and 6.1% for grain protein yield, respectively.

Effect of a translocation from Thinopyrum intermedium on preharvest-sprouting resistance in wheat lines.

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Preharvest-sprouting resistance is important for the production of grain from spring bread wheat in the Volga Region. The cultivars L503, L 505, Dobrynya (= L1089), and lines L 2032 and L 583) spring bread wheat have a translocation from *Th. elongatum* with *Lr19* and were resistant to preharvest sprouting (germination index from 0.12 to 0.32), but these cultivars and lines were susceptibile to the leaf rust population in Saratov.

The lines L400 and M6R, which have a translocation or whole chromosome from *Th. intermedium,* were resistant to the pathogen but highly susceptible to preharvest sprouting (germination index from 0.87 to 0.95). The F_7–F_{10} RIL populations with resistance to leaf rust and high grain yield and good quality flour is from a crosses between cultivars L503, L 505, Dobrynya, and lines L 2032 and L 583 (all red-grained) with two lines L400 and M6R (susceptible to preharvest spouting) were studied. A total of 41 lines and parents were grown in the field from 2003 to 2006. Each line was represented by a plot of seven 7-m rows with 0.15-m interrow spacing in a randomized complete-block design with four replications. Among the selected lines were 22 red-grained (germination index from 0.31 to 0.93) and 19 white-grained (germination index from 0.74 to 0.95) lines. A total of 41 lines carried the translocation or the whole chromosome of *Th. intermedium* with preharvest sprouting resistance lower than the better parent.

Preharvest-sprouting resistance of the red-grained sibs and three NIL pairs were significant higher than that of the white-grained lines. L204 (red grained) and L205 (white grained) NILs were identical and equally susceptible to preharvest spouting. The germination index of lines 'BC_1F_6-8Л2032*2/M6R' was significantly higher than that of L2032. L400 is a 400S sib line that does not have the *Th. intermedium* translocation. The preharvest-sprouting resistance of 400S was significantly higher than that of L400 only in 2003.

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Using of cultivar mixtures of soft spring wheat for improving technological qualities of grain in the Russian Far East.

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Developing cultivars with high technological and baking qualities is the most complicated problem in soft spring wheat selection in the Russian Far East (Shindin and Cherpak 2005). To resolve that problem, we are interested in mixtures consisting of cultivars that are remarkable for their technological and baking qualities. Some scientists determined that cultivar mixtures, as complicated populations, are resistant to abiotic and biotic stresses and have more stable yields and grain quality than homologues cultivars under changeable weather conditions (Sekun 1951; Martynyuk 1964; Kuzmin 1966; Vedrov et.al 1998).

We used the cultivars Khabarovchanka, Zaryanka, and Lira 98, grown in the Far Eastern region, for our mixture. Lira 98 is most valuable for food grain quality among the three cultivars. Lira 98 is used to improve the technological and baking features of Khabarovchanka and Zaryanka, which are less valuable but highly productive and resistant to lodging and disease. A two-cultivar mixture (Khabarovchanka + Lira 98) was 50:50, and the three-cultivar mixture (Khabarovchanka + Lira 98 + Zaryanka) was 33:33:33%.

A comparative analysis of the cultivars and their mixtures showed that Lira 98 and two mixtures turned out to be the best ones by their technological and baking qualities (Table 1). According to the State Standards of the Russian Federation (GOST RF), grain from all the cultivars conforms to the standard of an appreciable sort of wheat. Also important is that the cultivar mixtures yield similar to the initial cultivars in the years of drought, and 10–15% higher in the years of humid weather.

Table 1. Technological qualities of soft spring wheat cultivars and their mixtures (average for years 2001–02).

Cultivars and mixtures	Grain vitreousness (%)	Dough elasticity (alveograph, mm)	Elasticity and stretching ratio (alveograph units)	Flour strength (alveograph units)	Gluten content (%)	Bread output from 100 g of flour (mL)	Baking quality (mark)
Khabarovchanka	56	115	1.9	311	32.4	871	3.6
Zaryanka	55	134	2.4	331	33.5	950	3.8
Lira 98	77	121	1.7	497	37.0	1,010	4.2
Khabarovchanka + Lira 98	66	110	1.2	469	32.4	1,040	4.2
Khabarovchanka + Lira 98 + Zaryanka	61	106	1.0	438	35.2	1,000	4.0