

KIPA-INIA, NEW HIGH YIELD SPRING BREAD WHEAT VARIETY FOR CHILE

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ABSTRACT

Kipa-INIA is a spring wheat variety (*Triticum aestivum* L.) originated from a cross carried out in the Wheat Plant Breeding Project of the Instituto de Investigaciones Agropecuarias (INIA), in the Centro Regional de Investigación Quilamapu (36°31' S; 71°54' W) in 1993. It has an upright growth habit in the seedling stage. The adult plant is low to medium height and varies between 90 and 95 cm. The spike is white with long awns along its full length. The grain is ovate, white, and vitreous. It was sown in mid-August in the Santa Rosa Experimental Field, Chillán, head emergence occurred 90 to 95 d after sowing, i.e. is 4 to 6 d before 'Domo-INIA'. On the mean, 'Kipa-INIA' sown under irrigation conditions reached a yield of 11.7% higher than the control var. Domo-INIA, and 18.1% higher in dryland soils.

Key words: spring wheat, *Triticum aestivum*, new cultivar, Kipa-INIA.

Varieties of spring bread wheat are cultivated in a broad range of climates and soils in Chile and must meet various requirements in order to be registered as varieties. Among these requirements are high yield potential, good industrial quality, and good behavior towards diseases, especially foliar diseases. 'Kipa-INIA' meets these requirements and stands out for its high yield potential and wide adaptation, as well as exhibiting white vitreous grains.

Origin

Kipa-INIA is a spring wheat variety (*Triticum aestivum* L.) originating from a cross carried out in the Instituto de Investigaciones Agropecuarias (INIA) National Wheat Program in the Centro Regional de Investigación Quilamapu in 1993. The F₂ to F₇ selection stages were carried out between 1995 and 2000 using the pedigree method. It was evaluated in a preliminary yield trial in 2001 and included in the main yield trial in 2002. It was studied in INIA's standard (locations) yield trials between

2003 and 2008, and these trials were registered as variety trials from 2004 to 2007, applying for registration of varieties suitable for certification (RVSC), a condition required by the Ministry of Agriculture through the Servicio Agrícola y Ganadero (Agriculture and Livestock Service). It was identified in all these trials as QUP 3065-2001.

Crossing and pedigree

The following is the genealogy of Kipa-INIA:

QUP 1867-91/DOMO-INIA

C – 2636 – 5C – 2C – 8C – 1C – 1C – 0C.

Morphological description of the plant

This is a spring wheat variety with upright growth in the seedling stage. The adult plant is medium height between 90 and 95 cm (Figure 1). It normally exhibits plants with atypical height, which is common in semi-dwarf wheat varieties as indicated by Worland and Law (1985) and Storlie and Talbert (1993). The leaf sheath of the flag leaf has nil to very weak glaucosity. The auricle lacks antocianin, which explains its white color. The stalk medulla is thin and has low to moderate resistance to lodging.

Spike characteristics

The spike is white, semi-lax to semi-compact, approximately 10 to 11 cm long, strong glaucosity, semi-

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Received: 29 September 2010.

Accepted: 4 January 2011.

decumbent at maturity, pyramid-shaped, and long awns along its full length (Figure 2). The peak of the lower lemma of the spikelet in the middle Figure 2 third of the stem is straight.



Figure 1. Adult plant of Kipa-INIA planted in Quilamapu. Santa Rosa Experimental Station.



Figure 2. Spike of Kipa-INIA.

Grain characteristics

The grain is medium to large-sized, ovate, white, and vitreous. The percentage weight of seeds retained in a 2.3 mm oblong mesh sieve was 93% on the mean, and the weight of 1000 seeds was 44 to 48 g. It exhibits nil or very weak coloration to phenol.

Agronomic characteristics

It was sown in mid-August in the Santa Rosa Experimental Station (36°31' S; 71°54' W), Chillán, head emergence occurred 90 to 95 d after sowing, and was 4 to 6 d before 'Domo-INIA' (Mellado *et al.*, 1993).

Phytopathological characteristics

Up to the 2008-2009 season, var. Kipa-INIA showed resistance to moderate resistance to stripe rust (*Puccinia striiformis* West. f. sp. *tritici*), and leaf rust (*Puccinia triticina* Erikss.), and resistance to stem rust (*Puccinia graminis* Pers. f. sp. *tritici* Erikss. and Henn.), and low to moderate resistance to powdery mildew caused by the *Blumeria graminis* DC. f. sp. *tritici* Marchal fungus. It has exhibited resistance to leaf blotch (*Mycosphaerella graminicola* (Fuckel) J. Schröt.) (Tables 1 and 2).

Grain yield

Standard trials conducted in irrigated soils and dryland areas of Santiago, La Platina (33°34' S; 70°38' W); Ñuble, Quilamapu, (36°31' S; 71°54' W); Yungay (37°08' S; 72°0' W) Humán (37°26' S; 72°14' W); Temuco, Carillanca (38°41' S; 72°25' W); and Osorno, Purranque (36°31' S; 71°54' W) were evaluated from 2003 to 2008. In irrigated locations, 'Kipa-INIA' reached a mean yield of 11.7% higher than the control 'Domo-INIA' (Table 3), whereas the yield in dryland soils was 18.1% higher (Table 4). In all locations, whether irrigated or dryland, 'Kipa-INIA' was statistically equal to or higher than the control 'Domo-INIA' (Tables 3 and 4).

Quality

Kipa-INIA is a wheat variety with a good hectoliter weight and a hard texture. Numbers for Zeleny sedimentation, wet gluten, and protein classify it as intermediate wheat (INN, 2000). It exhibits good bread volume, high W value, and a good P/L ratio. This value is the relationship between dough tenacity and extensibility, a stability index used as a guideline to determine if dough has reduced, balanced, or high extensibility. In general, it is located in the category of wheat for direct bread-making (Table 5).

Table 1. Behavior of cv. Kipa-INIA to stripe rust (*Puccinia striiformis*), leaf rust (*P. triticina*), stem rust (*P. graminis*), powdery mildew (*Blumeria graminis*), and leaf blotch (*Septoria tritici*) in four irrigated locations.

Location	Year	Yellow rust ¹	Leaf rust ¹	Steam rust ¹	Powdery mildew ²	Leaf blotch ²
La Platina	2003	0	TR	0	5	0
	2004	0	0	0	0	0
	2005	0	0	0	0	0
	2006	0	0	0	0	0
	2007	0	0	0	0	0
	2008	0	0	0	0	0
Quilamapu	2003	0	5MS	0	2	0
	2004	0	5MR	0	0	0
	2005	5MR	TMS	0	0	0
	2006	0	5MS	0	0	3
	2007	5MS	TMS	0	0	0
	2008	20MR	5MS	0	0	0
Yungay	2003	0	0	0	3	0
	2004	0	0	0	0	0
	2005	0	TMS	0	0	0
	2006	0	0	0	0	0
	2007	0	0	0	0	0
	2008	0	0	0	0	0
Humán	2003	0	0	0	0	0
	2004	0	0	0	0	0
	2005	5MS	TMS	0	0	0
	2006	20MR	0	0	0	0
	2007	0	TMS	0	0	0
	2008	0	5MS	0	0	0

¹Values according to modified Cobb Scale (Peterson *et al.*, 1984) where attack intensity can vary between 0 and 100% (T = traces), plant reaction can be: resistant (R), moderately resistant (MR), moderately susceptible (MS), or susceptible (S).

²Values Saari and Prescott (1975) scale. Scale from 1 to 9.

Cultivation area and sowing dates

Data obtained in the standard trials allow recommending sowing 'Kipa-INIA' from the Metropolitan Region to the Los Lagos Region.

Sowing is recommended from June to August in irrigated soils, in May for interior dryland, from mid-June to mid-July in the dryland foothills, and from mid-August to the end of September in the wet dryland of the La Araucanía and Los Lagos Regions.

Electrophoresis of high molecular weight glutenins

'Kipa-INIA' exhibits allele 2* in *locus* Glu1A, allele 7 in *locus* GluB, and alleles 5+10 in *locus* Glu1D. In accordance with this classification, on a scale of 4 to 10, it reaches a value of 8.

Molecular analysis

This variety does not carry the rye translocation 1BL.1RS, contains the Pin-a hardness allele, and also exhibits the aluminum tolerant V allele for *locus* ALMT1.

Table 2. Behavior of cv. Kipa-INIA to stripe rust (*Puccinia striiformis*), leaf rust (*P. triticina*), stem rust (*P. graminis*), powdery mildew (*Blumeria graminis*), and leaf blotch (*Septoria tritici*) in three humid locations.

Location	Year	Yellow rust ¹	Leaf rust ¹	Stem rust ¹	Powdery mildew ²	Leaf blotch ²
Yungay*	2003	-	-	-	-	-
	2004	-	-	-	-	-
	2005	-	-	-	-	-
	2006	0	0	0	0	4
	2007	0	0	0	0	0
	2008	0	0	0	0	4
Carillanca	2003	0	0	0	0	3
	2004	0	0	0	0	0
	2005	0	5MR	0	0	0
	2006	0	0	0	0	4
	2007	0	0	0	0	0
	2008	0	10MR	0	0	5
Purranque*	2003	0	0	0	0	5
	2004	-	-	-	-	0
	2005	0	0	0	0	0
	2006	TR	0	0	0	5
	2007	0	0	0	0	0
	2008	-	-	-	-	-

¹Values according to modified Cobb Scale (Peterson *et al.*, 1984) where attack intensity can vary between 0 and 100% (T = traces), plant reaction can be: resistant (R), moderately resistant (MR), moderately susceptible (MS), or susceptible (S).

²Values Saari and Prescott (1975) scale. Scale from 1 to 9.

*Trial was not sown in Yungay in 2003, 2004, and 2005, and in Purranque in 2004 and 2008.

Table 3. Grain yield of cv. Kipa-INIA compared to control cv. Domo-INIA in standard trials conducted in four irrigated locations from 2003 to 2008.

Location	Year	Cultivars	
		Kipa-INIA	Domo-INIA
		t ha ⁻¹	
La Platina	2003	7.11a	6.38a
	2004	6.51a	5.96a
	2005	6.01a	5.84a
	2006	2.85a	3.40a
	2007	7.39a	5.64b
	2008	4.21a	5.15a
	Mean	5.68	5.39
Chillán	2003	8.59a	6.40b
	2004	9.56a	8.33b
	2005	9.78a	8.99a
	2006	10.12a	9.75a
	2007	5.96a	6.98a
	2008	9.31a	9.67a
	Mean	8.89	8.35
Yungay	2003	8.64a	7.09b
	2004	6.91a	5.25b
	2005	8.67a	6.92b
	2006	10.44a	10.21a
	2007	9.25a	7.69b
	2008	10.12a	8.27b
	Mean	9.01	7.57
Humán	2003	7.42a	5.82b
	2004	8.64a	8.13a
	2005	10.19a	9.29a
	2006	10.97a	9.26b
	2007	9.05a	8.82a
	2008	9.17a	7.86b
	Mean	9.24	8.19

Different letters between cultivars for each year and location are statistically different at $P < 0.01$.

Table 4. Grain yield of cv. Kipa-INIA compared to control cv. Domo-INIA in standard trials conducted in three humid locations from 2003 to 2008.

Location	Year	Cultivars	
		Kipa-INIA	Domo-INIA
		t ha ⁻¹	
Yungay	2003	-	-
	2004	-	-
	2005	-	-
	2006	8.21a	6.71b
	2007	9.63a	8.85b
	2008	6.88a	6.71a
	Mean	8.24	7.42
Carillanca	2003	9.77a	8.12b
	2004	9.20a	8.27a
	2005	8.54a	6.56b
	2006	9.48a	3.04b
	2007	7.66a	8.69a
	2008	7.85a	7.84a
	Mean	8.75	7.09
Purranque	2003	9.29a	8.11a
	2004	-	-
	2005	12.26a	9.66b
	2006	7.72a	7.43a
	2007	10.55a	8.04b
	2008	-	-
	Mean	9.95	8.31

Different letters between cultivars for each year and location are statistically different at $P < 0.01$.

Trial was not sown in Yungay in 2003, 2004, and 2005, and in Purranque in 2004 and 2008.

Table 5. Quality characteristics of cv. Kipa-INIA compared to control cv. Domo-INIA.

Characteristics ⁽¹⁾	Cultivars	
	Kipa-INIA	Domo-INIA
Hardness index, % ⁽²⁾	15.90	17.70
Hectoliter weight, kg hL ⁻¹	84.02	81.78
Zeleny sedimentation, cm ³⁽³⁾	33.00	29.80
Wet gluten, % ⁽⁴⁾	37.15	39.73
Protein (N x 5.7), %	9.90	9.80
Falling number, s ⁽⁷⁾	458	416
Work (W) ⁽⁵⁾	190	176
Tenacity (P)	135	93
Extensibility (L)	34	59
Ratio (P/L)	3.97	1.57
Bread volume, cm ³⁽⁶⁾	1125	1000

⁽¹⁾Mean values of trials conducted in La Platina, Chillán, Yungay, Humán, Yungay-S, Carillanca, and Purranque from 2003 to 2007.

⁽²⁾Values of < 20: hard grain; 20-30: semi-hard grain; > 30: soft grain.

⁽³⁾Numbers from 17 to 26.9 cm³ soft wheat; 27 to 32.9 cm³ intermediate wheat, and ≥ 33 cm³ strong wheat.

⁽⁴⁾Values from 18 to 24.9: soft wheat; 25.0 to 29.9: intermediate wheat; ≥ 30: strong wheat.

⁽⁵⁾W value (alveogram): < 150: low; 150-200: medium; > 200: good.

⁽⁶⁾Bread volume: < 550: low; 550-600: good; > 600: very good.

⁽⁷⁾Protein, Falling number and hardness index, mean of 28 values in seven locations, in 2004, 2006, and 2007.

Evaluation scale source: INN, 2000, Laboratorio Farinología del Instituto de Investigaciones Agropecuarias (INIA) and Granotec.

CONCLUSIONS

This is a new variety of spring bread wheat with a good yield potential, good hectoliter weight, and hard texture. The grain is medium to large-sized, white, and vitreous. Numbers for Zeleny sedimentation, wet gluten, and protein classify it as intermediate wheat. In general, it is located in the category of wheat for direct bread-making. It exhibits resistance to moderate resistance to stripe rust, leaf rust, stem rust, powdery mildew, and leaf blotch.

Data obtained in the standard trials allow recommending sowing var. Kipa-INIA from the Metropolitan Region to the Los Lagos Region.

RESUMEN

Kipa-INIA, nueva variedad de trigo harinero de primavera de alto rendimiento para Chile. Kipa-INIA es un trigo harinero (*Triticum aestivum* L.) de primavera que proviene de un cruzamiento efectuado el año 1993 en el Proyecto de Fitomejoramiento de Trigo del Instituto de Investigaciones Agropecuarias (INIA), en el Centro Regional de Investigación Quilamapu. Es un trigo con hábito de crecimiento erecto al estado de plántula. La

altura de la planta adulta se considera mediana, y varía entre 90 y 95 cm. La espiga es de color blanco, de barbas largas presentes en toda su extensión. El grano es de color blanco, aspecto vítreo, y forma ovada. Sembrado a mediados de agosto en el Campo Experimental Santa Rosa (36°31' S; 71°54' O), Chillán, la emisión de espigas ocurre 90 a 95 días después de la siembra, entre 4 a 6 días antes que 'Domo-INIA'. En promedio sembrado bajo condiciones de riego, 'Kipa-INIA' alcanzó un rendimiento medio 11,7% mayor que la variedad testigo Domo-INIA y en suelos de secano tuvo un rendimiento superior de un 18,1% respecto de 'Domo-INIA'.

Palabras clave: trigo de primavera, *Triticum aestivum*, nuevo cultivar, Kipa-INIA.

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