Kazakhstan farmers adapt Australian farming technology

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AT A GLANCE…

This article describes the results of research into the direct sowing of agricultural crops using narrow tynes in northern and western Kazakhstan compared with a traditional way of sowing using wide tynes.

Note that northern Kazakhstan has a short growing season. They plant wheat in late May and grow the crop through their summer for harvest before the first frosts of autumn.

THE main limiting factor in the production of crops in northern Kazakhstan is moisture. The average yield of cereals in recent years is 1.2 tonnes per hectare, with a range from 0.3 to 0.5 tonnes per hectare in dry years, to 1.7 to 2.0 tonnes per hectare in wet years.

To help overcome this yield variation, Kazakhstan farmers and researchers have focused on new moisture-saving technologies such as zero till and minimal till. In particular, they have looked at zero till technology with a reduced seeding rate in the wheat belt of Australia, where moisture is also the limiting factor in many years. For moisture-saving technologies, the most important factor is the choice of the method of sowing and openers/tynes for its implementation.

From 2012–15, we made production tests of the 'Australian' technology of direct crop sowing in the stubble of the previous crops, which involves seeding with an anchor tyne/narrow spike and sowing rates reduced by 30–50 per cent. The planter used was an Australian Rogro planter, using a 1.6 cm tyne opener and a row spacing of 30–40 cm.

This was compared with sowing with conventional sweep/shovel belt planters on a row spacing of 23–25 cm and a seeding depth of 7–8 cm. The Rogro planter makes it possible to set the depth of the sowing in the furrow up to 20 cm down from the surface but with a seed depth only of 3–6 cm.

In arid conditions, this allowed sowing to be carried out in a deeper and more moist soil as the top layer had dried out.

Co-author Madina Brimzhanova (left) and a research colleague measure a well grown wheat crop in northern Kazakhstan.

In the experiments, the width of the row spacing, the seeding rate and the timing of sowing were varied. The size of production plots was from 100 to 400 hectares on three farms located in different soil and climatic zones:

- Zhanakhai farm has an average annual rainfall of 360 mm. Soils are represented by ordinary chernozems, mostly of heavy clay composition.
- LLP 'Ramazan-K' has an average annual precipitation of 250–280 mm. Soil cover of most fields is represented by southern chernozems, and the soil type is heavy loam.
- LLP 'Kumkudyk' is located 150 km west of the second farm and has an annual precipitation of about 200–220 mm on chestnut, loamy soils.

The 2012 season turned out to be extremely dry. At the time of sowing, soil moisture was at a depth of more than 10 cm, and during the growing period (from May 20 to August 1), no more than 20 mm of rain fell. The high temperatures meant that this rain had virtually no effect on plant development.

The 2013 and 2014 seasons were also dry for LLP 'Kumkudyk'. The climatic conditions at the farms for each season are presented in Table 1. The climatic conditions across years and farms were very different, and they underline the risky conditions of farming in northern and western Kazakhstan.

What we found

2012 season

The results of the research in 2012 at Zhanakhai farm are presented in Table 2. In the drought conditions of 2012, it was very useful to set the depth of the shank of the Rogro planter down to 20 cm. This allowed us to 'seek the moisture' below drying surface layers and to sow the seeds in the moist soil layer. Shoots after sowing with the Rogro were very uniform and

TABLE 1: Climatic conditions for production trials

Name of the company	May	June	July–August
Year 2012			
KH Zhanakhai	Air drought	Air and soil drought	July – drought, August – rain
Year 2013			
KH Zhanakhai	Dry	Air and soil drought	Rain
LLP Kumkudyk	Air drought	Air and soil drought	Air and soil drought
Year 2014			
KH Zhanakhai	Wet	Wet	Rain
LLP Kumkudyk	Air drought	Air and soil drought	Air and soil drought
Year 2015			
LLP Ramazan	Wet	Air and soil drought	July – drought, August – rain

protected from dry winds, as they were in the groove/furrow formed by the narrow tyne.

In the extremely arid conditions of 2012, the use of direct sowing with narrow tynes with increased row spacing – and reduction in the seeding rate – provided a significant increase in the yield of wheat, flax, rapeseed (canola), sunflower and soybean. And direct costs of sowing were reduced in wheat, sunflower and soybean crops due to lower fuel and seed costs.

2013 season

The results of 2013 research on the farms Zhanakhai and Kumkudyk LLP are given in Table 3.

It should be noted that the wheat crops seeded at the beginning of the sowing season on May 22 in the Zhanakhai farm experienced severe stress from the June drought.

The combination of wide row spacing, lower seeding rate, and narrow tyne as compared to the sweep, allowed the wheat to be less stressed as tillering was increased by 1.6 times and the density of the wheat was increased. There was also a small increase in yield of 0.04 tonnes per hectare, which was not significant, and a small saving of direct seeding costs.

The later seeded wheat (May 29 to June 1) at farm Zhanakhai endured the June drought better than the earlier seeded wheat. July rains improved the crop, especially the plots that were

TABLE 2: Influence of the method of sowing on the costs and yields of wheat, rapeseed (canola), flax, sunflower and soybean in the Zhanakhai Farm (2012)

Seeder	Conventional sweep 5CTC-2	Direct Rogro narrow tyne	Conventional sweep Case ATX	Direct Rogro narrow tyne	Conventional sweep 5CTC-2	Direct Rogro narrow tyne	Conventional sweep 5CTC-2	Direct Rogro narrow tyne	Conventional sweep 5CTC-2	Direct Rogro narrow tyne
Crops	**Durum**		**Rapeseed**		**Flax**		**Sunflower**		**Soybean**	
Space between rows, cm	22.8	40.0	25.4	40.0	22.8	40.0	69	60.0	22.8	30.0
Seeding rate, kg/ha	195	65	8.0	3.0	40	20	8.0	3.0	110	70.0
Yield, tonnes/ha	0.3	0.7	0.2	0.68	0.2	0.8	0.39	0.52	0.30	0.65
Difference in yield, tonnes/ha		+0.4*		+0.48*		+0.60*		+0.13*		+0.35*
Financial impact, $AUD/ha#		+69		+121		+182		+41		+148

*= Significant difference # Converted to Australian dollars from Kazakhstan Tenge

seeded with sweeps. But the obtained yield increase when sown with sweep was not significant. Although the yield was higher when sowing with the sweep, the Rogro produced 40 per cent more tillers, the 1000 kernel weight increased by 2 grams, and the density increased by 21 g/l.

In more arid conditions at Kumdudyk LLP there was also no significant difference in yield due to seeding methods in 2013. At the same time, direct sowing with the Rogro with a reduced seeding rate increased 1000 kernel weight by 4 grams, increased grain density of 16 g/l and tillers increased by 6 per cent.

2014 season

On ordinary chernozems at the Zhanakhai farm in wet conditions in 2014, sowing with the Case ATX-700 with sweeps and a row spacing of 25.4 cm was compared to direct sowing with the Versatile Noble–2000 with narrow tynes and a row spacing of 20.3 cm (see Table 4).

In the wet conditions of 2014, the reduced seeding rate with narrow tynes increased tillering by 20 per cent, and increased the wheat density by 12 g/l as compared to the crop seeded with a sweep at a regular seeding rate.

In the conditions of a very severe spring and summer drought in 2014 at LLP Kumkudyk, direct sowing with the Rogro increased tillering by 20 per cent and gave a significant yield increase of 0.24 tonnes per hectare in comparison with a conventional planter with a sweep shovel.

2015 season

The results of comparing the methods of sowing in 2015 at Ramazan farm are presented in Table 5.

Under conditions of sufficient moisture in the spring and the second half of summer, with the June air drought, direct seeding with 40 cm and 30 cm row spacing with narrow tyne and a 30 per cent reduction in the seeding rate produced a yield increase of 35–78 per cent over the conventional planter. Tillering increased significantly and the 1000 kernel weight also increased by 3–4 grams.

To sum up

In wet spring-summer conditions, the use of conventional seeders with sweeps with a zonal seeding rate may provide an equal or slightly higher yield of wheat compared to the use of seeders with narrow tynes and a reduced seeding rate. But this increase in yield is not statistically significant.

TABLE 3: Influence of the date and method of sowing on the plant stand, tillering, yield and costs of wheat at Zhanakhai Farm and Kumkudyk LLP (2013)

	Zhanakhai Farm				Kumkudyk LLP	
	Early plant May 22		Later plant June 2			
	Case ATX 700	Rogro	Case ATX 700	Rogro	Flexi-Coil 5000	Rogro
Seeder	Belt 4 cm (sweep shovel)	Direct with narrow tyne	Belt 4 cm (sweep shovel)	Direct with narrow tyne	Belt 4 cm (sweep shovel)	Direct with narrow tyne
Crop	Hard wheat		Hard wheat		Soft wheat	
Space between rows, cm	25.4	40.0	25.4	40.0	30.5	40.0
Seeding rate, kg/ha	91	65	100	55	85	51
Plants per square metre by harvest time	203.7	101.9	209.0	119.4	154.6	123.8
Average productive tillering	1.45	2.36	1.64	2.30	1.40	1.49
Yield, tonnes/ha	1.59	1.63	2.35	2.05	1.09	1.11
Difference in yield, tonnes/ha		+0.04^		–0.3^		+0.02^
^ Not significant						

TABLE 4: The effect of sowing method and seeding rate of wheat on wheat production and cost of wheat production at farm Zhanakhai and Kumkudyk LLP in 2014

	Zhanakhai farm		Kumkudyk LLP	
	Seeder			
	Case ATX 700	Versatile Noble 2000	Flexi-Coil 5000	Rogro
Method of sowing	Belt 4 cm (sweep shovel)	Direct with narrow tyne	Belt 4 cm (sweep shovel)	Direct with narrow tyne
Crop	Soft wheat			
Space between rows, cm	25.4	20.3	30.5	34.0
Seeding rate, kg/ha	150	100	100	60
Plants per square metre by harvest time	169.0	194.6	74.2	84.9
Productive tillering	2.00	2.40	1.22	1.48
Weight of 1000 grains	34.1	34.2	30.1	33.5
Weight per 1 litre, gr/l	781	793	800	810
Yield, tonnes/ha	2.23	2.68	0.24	0.48
Difference in yield, tonnes/ha		+0.45^		+0.24*
Financial impact, $AUD/ha#		+16		+41

*= Significant difference ^ Not significant # Converted to Australian dollars from Kazakhstan Tenge

FIGURE 1: Comparison of wheat plants with different methods of sowing in a dry year

Right: A traditional sowing with sweeps.
Left: Sowing with narrow spike in accordance with adapted Australian technology.

Kazakhstan growers have been impressed with the results of the "Australian" technology.

But reducing the row spacing of the narrow tyne planter in wet years can more than compensate for this (see Table 4, farm Zhanakhai).

The Australian direct seeding technology really comes into its own in dry seasons.

In conditions of spring and summer air and soil drought, direct seeding with narrow tynes with a row spacing of 30 cm on wheat and a row spacing of 40 cm on rapeseed (canola) and flax with a 30–50 per cent reduction in seeding rates ensures a reliable increase in yield. In wheat this was around 2 to 2.3 times, in sunflower by 1.3 times (at a row spacing of 60–70 cm), in flax and rapeseed (canola) by 3 to 4 times compared to conventional sowing (Table 2).

In arid spring-summer conditions when sowing rapeseed and flax, the row spacing is justified up to 40 cm, and 30 cm in soybean when sowing with narrow tynes.

In conditions of sufficient moisture in the spring and the second half of summer – but a dry June and the first half of July – a decrease in the row spacing from 40 to 30 cm when sowing wheat with narrow tynes can increase yields up to 30 per cent with equal seeding rates (see Table 5, Ramazan-K LLP, 2015).

For all years of observation, the direct drilling technology increased wheat tillering by 20 to 60 per cent, gave two to four grams more weight of 1000 grains and the weight of the grain per litre was 12–36 g/l higher.

One of the main impediments to lower seeding rates has been that weed competition can be more severe. But there is now a sufficient selection of effective herbicides to overcome this.

Another drawback is that the growing period may be extended in crops with lower plant populations. This is particularly important in areas with a short growing season such as northern Kazakhstan. And it can become a real problem in seasons with low summer temperatures and/or early autumn frosts.

- When switching to reduced seeding rates, firstly, measures must be taken to clear the field of weeds.
- Secondly, reduced seeding rates should be used when soil moisture reserves are low, and planting should take place at the beginning of the optimal planting window – that is, in the second half of May.
- Care must also be taken to ensure high quality seed and seed treatments for uniform germination. With the right approach to this innovative technology, farmers can reduce costs for seed purchase and transportation, storing seeds, seed treatment and halve the time it takes to load the seeders.

The application of direct seeding in the conditions of northern and western Kazakhstan using adapted Australian technology makes it possible to guarantee the increase of crop yields in arid conditions and to at least maintain yields equal to sowing with conventional sweep/shovel planters in wet years.

TABLE 5: Influence of the sowing method on the costs and productivity of wheat at Ramazan-K LLP (2015)

Indicators	Seeder		
	Horsch ATD 11.35	Rogro	Rogro
Method of sowing	Belt 4 cm (sweep shovel)	Direct with narrow tyne	Direct with narrow tyne
Crop	**Soft wheat**		
Date of sowing	23/05/15	23/05/15	26/05/15
Background, previous crop	Stubble after wheat	Stubble after wheat	Stubble after wheat
Space between rows, cm	33.0	30.0	40.0
Seeding depth, cm	7.9	7.7	7.5
Seeding rate, kg/ha	120	80	80
Plants per square metre at harvest	165.0	174.4	128.8
Productive tillering	1.20	1.81	1.62
Weight of 1000 grains, gr	28.4	31.5	32.3
Yield, tonnes/ha	0.81	1.44	1.09
Difference in the yield, tonnes/ha		+0.63*	+0.28*
Financial impact $AUD/ha#	—	+89	+43

*= Significant difference # Converted to Australian dollars from Kazakhstan Tenge

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