

**Research Article**

## **The Effect of Specifics of Cultivation Technology on Sowing Quality of OATS**

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The significance of the seed quality in agriculture has known for a long time. This is the factor which directly determines the harvest yield and quality. Modern oats varieties have high yield potential, however even the best variety in order to attain inherent productivity requires proper agricultural conditions, namely the development and adoption of variety-specific cultivation technology [8, 9, 10, 13, 14, 16].

The effect of many different elements of cultivation technology on the oats seed quality has been studied extensively. It is stated that the seeds obtained from the later planting dates exhibit 10–12% less seed vigor and 7–14% less seed germination in laboratory conditions [3]. The significant loss in yield and seed quality may occur during the crop harvesting as well. Both premature harvesting of the crops the early stages of waxy ripeness with high grain humidity and harvesting of overripe crops result in the drop in the sowing quality of seeds. As it pointed out the harvesting of the seeds areas

should be performed in the late waxy ripeness stages [2, 7, 11, 12]. The problem of finding the optimal sowing rate for cereals has been under investigation by generations of researchers. After V.Ya.Yuriev [15] each variety has its own intrinsic sowing density which is tightly coupled with a host of biological properties of the plants. The sowing rate of different varieties of the same crops cultivated within the same conditions might vary by a factor of 1,5–2,0. With the continuing emergence of new varieties the latter sowing rate problem is here to persist.

**The method.** The field trials have been conducted on the experimental field of Perm State Agricultural Academy during the 2013–2015 seasons. The aim was to establish the agrotechnology for the oats of Konkur and Dens varieties within the Middle Urals region conditions in order to attain the high quality of the sowing properties of the oats grain. The research objectives encompassed the determining of the seed resilience and viability

in laboratory conditions, vigor and uniformity of germination of the oats seeds with respect to predecessor and sowing rate. The three-factor experiment was established on the sod-podzolic heavy loam moderately cultivated soil with humus content of 2,2–2,4%, neutral pH<sub>KCl</sub> value of 6,3–6,5, high content of mobile phosphorus and exchangeable potassium. The A factor is the predecessor (winter rye, meadow clover, barley, peas), the B factor is the oats variety (Konkur, Dens), the C factor is the sowing rate (4, 5, 6 mil. seeds per hectare). The experiment variants were placed systematically, in split plot pattern. The experiment's agrotechnology was set up in accordance with the Perm region agricultural system for early summer cereals [1] with specified predecessor for oats. The tillage included stubble breaking (plough tilling after clover) followed by the full depth fall plowing in autumn, early spring double-row harrowing and pre-sowing cultivation with 8-10 cm depth double-row harrowing of the soil reaching sowing-ready condition. A N<sub>30</sub>P<sub>30</sub>K<sub>30</sub> fertilizer

sowing quality of seeds has been determined in accordance with GOST[4, 5, 6].

Meteorological conditions for the 2013-2015 seasons can be characterized as contrasting: while years 2013 and 2014 favored the seeds formation, growing and ripening, July and August of year 2015 were distinctive by high humidity and low temperature which increased growing and ripening stages' duration for oats grain.

**Experiment results.** The experiments have shown that the oats varieties under investigation in the Middle Urals region form seeds of high seeding quality regardless of meteorological conditions taking place during growth. The viability of seed was determined as percentage of live seeds. It was found that predecessor and sowing rate have significant effect on the seed viability (see Table 1).

**Table 1.** Average seed viability with respect to predecessor and sowing rate, in %, over 2013-2015 years.

The estimated viability of the oats seeds grown

Predecessor (A)	Variety (B)	Sowing rate, mil. seeds per hectare (C)			AB factors average	A factor average	B factor average
		4	5	6			
Winter rye	Dens	98	97	95	97	97	96
	Konkur	99	97	97	98		96
Meadow clover	Dens	98	97	96	97	97	
	Konkur	98	98	97	98		
Peas	Dens	96	96	95	96	96	
	Konkur	98	96	96	97		
Barley	Dens	95	95	93	94	94	
	Konkur	94	94	93	94		
Averaged over B <sub>1</sub> C		97	96	95	-	-	
Averaged over B <sub>2</sub> C		97	96	96	-	-	
		A	B	C			
LSD <sub>05</sub> of main effects		1,3	F <sub>1</sub> <F <sub>t</sub>	0,3			
LSD <sub>05</sub> of partial differences		2,8	F <sub>1</sub> <F <sub>t</sub>	1,1			

has been applied for oats during the pre-sowing cultivation stage. The sowing has been performed in single day after the 3-4 cm depth harrowing with SSNP-16 sowing machine with the sowing rate specified according to the experiment plan. The herbicide treatment encompassed application of Agritoks with 2 kg per hectare. The cropping has been performed in single run with Niva SK-5 harvester. The

after winter rye and meadow clover was 97%, whereas the oats seed viability grown after peas and barley was 96% and 94%, respectively. The effect of sowing rate on the viability was found to be more significant. Namely, the highest viability was obtained at the lowest (4 mil. per hectare) sowing rate: both oats varieties have shown the highest viability with 98-99% which is 2-3% higher than in the case of 6 mil. seeds per hectare sowing rate.

The seed vigor was determined on the fourth day after sowing in laboratory conditions. While parameter is not standardized by GOST, it is however assumed that the seed quality has positive correlation with vigor. The seed viability in laboratory conditions is covered by the GOST R 52325-2005 standard and it must not be less than 92%. The varieties' results comparison has shown that the Konkur variety has an edge over the Dens variety with 73% vigor for the former which is 1% higher than for the latter ( $LSD_{05} = 0,4\%$ ). The seed viability for

the Konkur variety (96%) was found to be 1% higher as well.

The predecessor was found to have slight effect on vigor and seed viability in laboratory conditions (Table 2): no predecessor effect was observed for winter rye, meadow clover and peas with 73-74% vigor and 96% seed viability. The lowest vigor with 70% level was obtained for case of barley. Similar results were obtained for viability: employing barley as a predecessor resulted in 3% drop of viability from 93% level obtained for winter rye, meadow clover and peas ( $LSD_{05} = 1,5\%$ ).

**Table 2** – Average seed viability (vigor) with respect to predecessor and sowing rate, in %, over 2013-2015 years.

Predecessor (A)	Variety (B)	Sowing rate, mil. seeds per hectare (C)			AB factors average	A factor average	B factor average
		4	5	6			
Winter rye	Dens	97 (74)	95 (72)	93 (71)	95 (72)	96 (73)	95 (72)
	Konkur	98 (75)	96 (74)	96 (73)	97 (74)		96 (73)
Meadow clover	Dens	97 (74)	96 (73)	94 (73)	96 (73)	96 (74)	
	Konkur	98 (77)	97 (75)	96 (74)	97 (75)		
Peas	Dens	95 (73)	96 (72)	94 (71)	95 (72)	96 (73)	
	Konkur	97 (75)	96 (73)	95 (71)	96 (73)		
Barley	Dens	94 (71)	93 (70)	91 (68)	93 (70)	93 (70)	
	Konkur	93 (70)	93 (69)	92 (68)	93 (69)		
Averaged over B <sub>1</sub> C		96 (73)	95 (72)	93 (71)	-	-	
Averaged over B <sub>2</sub> C		97 (74)	96 (73)	95 (72)	-	-	
		A	B	C			
LSD <sub>05</sub> of main effects		1,5 (1,7)	0,4 (0,4)	0,4 (0,4)			
LSD <sub>05</sub> of partial differences		3,2 (3,5)	1,3 (1,4)	1,2 (1,2)			

On the contrary, the sowing rate was found to have significant effect on vigor and seed viability: both oats varieties tend to form seeds with higher vigor and viability at a lower seeding rate. More specifically, the sowing rate of 4 mil. seeds per hectare yielded the vigor level of 73% and 74% for Dens and Konkurs varieties, respectively, which is 1% and 2% higher than in the case of sowing rate of 5 and 6 mil. seeds per hectare ( $LSD_{05} = 0,4\%$ ). This trend holds true for the seed viability: the sowing rate of 4 mil. seeds per hectare yielded the viability level of 96% for both varieties, which is 1% and 2% higher than in the case of sowing rate of 5 and 6 mil. seeds per hectare ( $LSD_{05} = 0,4\%$ ).

The probe for uniformity of germination has revealed the discrepancy between two varieties: the Konkur variety has 0.2% higher coefficient of uniformity of germination (CUG) compared to the Dens variety (with CUG value of 23,7%). Following the other investigated seed qualities, the uniformity of germination favors the winter rye, meadow clover and peas predecessors whose respective CUG values are 0,8%, 0,9% and 0,7% higher than for the case of barley predecessor (with CUG value of 23,2%)( $LSD_{05} = 0,34\%$ ).

**Table 3** – Average coefficient of uniformity of germination with respect to predecessor and sowing rate, in %, over 2013-2015 years.

Predecessor (A)	Variety (B)	Sowing rate, mil. seeds per hectare (C)			AB factors average	A factor average	B factor average
		4	5	6			
Winter rye	Dens	24,3	23,7	23,6	23,9	24,0	23,7
	Konkur	24,5	24,1	24,0	24,2		23,9
Meadow clover	Dens	24,3	23,9	23,7	24,0	24,1	
	Konkur	24,4	24,3	24,1	24,3		
Peas	Dens	23,8	23,9	23,6	23,8	23,9	
	Konkur	24,3	23,9	23,7	24,0		

Barley	Dens	23,4	23,4	22,7	23,2	23,2
	Konkur	23,3	23,3	23,1	23,2	
Averaged over B <sub>1</sub> C		24,0	23,7	23,4	-	-
Averaged over B <sub>2</sub> C		24,1	23,9	23,7	-	-
		A	B	C		
LSD <sub>05</sub> of main effects		0,34	0,09	0,09		
LSD <sub>05</sub> of partial differences		0,73	0,32	0,29		

The Dens variety exhibits noticeably higher CUG value (24%) for the case of 4 mil. seeds per hectare sowing rate, which appears to be 0,3% and 0,6% higher than for the respective sowing rates of 5 and 5 mil. seeds per hectare. The Konkur variety performs similarly with CUG value (24.1%) for the case of 4 mil. seeds per hectare sowing rate, which is 0,2% and 0,4% higher than for the respective sowing rates of 5 and 5 mil. seeds per hectare (LSD<sub>05</sub> = 0,09 %).

The Konkur variety has larger and heavier grain than Dens which average mass of 1000 seeds of 36.7 grams for the former which is 5.7 grams heavier than for the latter (Table 4). The heaviest Konkurs variety grains were obtained in cases of winter rye (40,9 grams) and meadow clover (40,7 grams) predecessors with 4 mil. seeds per hectare sowing rate.

**Table 4** – Average mass of 1000 seeds with respect to predecessor and sowing rate, in grams, over 2013-2015 years.

Predecessor (A)	Variety (B)	Sowing rate, mil. seeds per hectare (C)			AB factors average	A factor average	B factor average
		4	5	6			
Winter rye	Dens	32,8	31,5	30,4	31,6	35,4	31,2
	Konkur	40,9	39,1	37,9	39,3		36,9
Meadow clover	Dens	35,7	34,7	34,2	34,9	37,4	
	Konkur	40,7	40,3	38,8	39,9		
Peas	Dens	31,6	29,7	28,3	30,9	32,4	
	Konkur	36,6	34,7	33,4	35,9		
Barley	Dens	29,4	28,3	27,2	28,3	30,9	
	Konkur	34,6	33,7	32,0	33,4		
Averaged over B <sub>1</sub> C		32,4	31,1	30,0	-	-	
Averaged over B <sub>2</sub> C		38,2	37,0	35,5	-	-	
		A	B	C			
LSD <sub>05</sub> of main effects		3,4	2,2	1,2			
LSD <sub>05</sub> of partial differences		4,0	3,5	2,0			

The computation of linear correlation has revealed a strong coupling between the seed mass and sowing quality parameters: seed resilience ( $r=0,70\pm 0,15$ ), vigor and uniformity of germination ( $r=0,75\pm 0,14$ ), seed viability ( $r=0,73\pm 0,15$ ) regardless the meteorological conditions during growth.

## CONCLUSIONS.

As a result, at three-year field experiment has shown that the best predecessors for oats are winter rye, meadow clover and peas; the most profitable sowing rate is 4 mil. seeds per hectare. The highest attained results are 96-99% for seed resilience, 73-77% for vigor, 95-98% for seed viability and 23,8-24,5% for uniformity of germination. The Dens oats variety was found to be slightly inferior to the Konkurs large grain oats variety in terms of sowing quality. These obtained results tend to be stable over the experiment period.

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