YIELD POTENTIAL OF RYE, HYBRID AND POPULATION VARIETIES IN ECOLOGICAL AND INTENSIVE CULTIVATION*

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Three years' trials were established to study the winter rye yield of hybrid and population varieties in four locations and at two levels of cultivation intensity and in ecological agriculture. The first level of intensity was used for the treated seed, herbicide and basic nitrogen fertilization, in the second intensity, except treated seed and herbicides, higher nitrogen fertilization, and also fungicide, insecticide and growth regulator were applied. The ecological system of growing was based on certified conditions according to the Regulation of the Ministry of Agriculture of the Czech Republic No. 242/2000 Collection of Laws and Instructions of IFOAM. Higher yielding capacity of winter rye hybrid varieties was confirmed when compared the varieties of the population in all monitored cultivation regions and in ecological agriculture. Higher intensity of cultivation brought an increase of the yields in both groups of varieties, but the hybrid varieties had higher increase of the yields than population varieties cultivated with higher intensity. Hybrid varieties responded by increased intensity. In ecological agriculture hybrid varieties were more yielding and yield differences among hybrid and population varieties were smaller than in intensive conditions. The differences among varieties were not statistically significant. Rye is a suitable crop for ecological agriculture. Yield differences recorded among hybrid varieties in intensity cultivation I and II were not statistically significant. The variety Dankowskie Nowe was more yielding among population varieties under lower intensity. When evaluating the yields in different production regions, it was confirmed that the rye can better utilize less fertile soils. For example, the yields were almost identical in potato-growing region and in more fertile sugar beet-growing region. The weather in different years and locations had a decisive effect on the level of yields. Detailed analysis showed that the weather pattern had a crucial effect in April and in May when abundance of precipitation and colder weather in this period ensured the highest yields in both groups of varieties. Higher productivity potential of the stand was reached under such conditions (establishment of greater number of strong tillers, mostly fertile), and higher potential productivity of spike (the number of spikelets and florets is formed in April and realize in May, hence also bring higher number of grains in spike). The yield is formed predominantly by productivity of spike in hybrid varieties. The experiment was negatively affected by extremely arduous winter that appears once a hundred years. Very high frost-hardiness and general resistance to winter conditions was observed in rye (hybrid varieties as well as populations).

rye; yield of hybrid and population varieties; ecological and intensive cultivation

INTRODUCTION

The rye in Europe in the previous century lost its leading position among cereals. Still it has been considered as a typical bread crop. It still has an importance as a cereal species suitable for less fertile, sandy soils and in regions situated at higher altitude and LFA (Less Favoured Area). Its high frost-hardiness and capacity to use nutrients from less available forms is applied here. Its aridity-hardiness is also considered as an important quality respecting calescence of the weather in the central Europe. It has its importance in conditions where the other species are less fertile. It is fully used in Poland and Germany where they have a programme for more extensive utilisation of rye when alongside with a traditional utilisation of rye in food they are concentrated on application of the rye in feed mixtures and for bio-ethanol production (Gerdes, 2004). For bread baking it was replaced by wheat that has more favourable (stable) technological qualities for industrial production in large bakehouses and also enables to prepare wider assortment of the bakery products (Petr et al., 1999). The rye was more suitable for small production individual baking when different technological properties of each part of flour could be taken into account. The dominant position of wheat was also conditioned by faster growth of its yields thanks to the intensive breeding worldwide. On the contrary, the progress in rye breeding was very slow for a long time, what was associated with a low species diversity and a narrow spectrum of gene sources for breeding (Wilde, 1993). New varieties by the yield did not respond to existing intensification factors. Breeding of traditional pop-

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ulation varieties was the most successful in Poland. Hybrid varieties that represent a revolutionary progress in rye breeding were bred successfully in Germany. Yet the first data on the yields of hybrid varieties manifested a high production potential compared with the present population varieties (Wilde, 1990; Anonymous, 1990, 1996; Company materials Lochow-Pekus).

In the Czech Republic, too, at the beginning of the 1990s in state variety experiments these varieties have already been studied and the first certified variety Marder had the yields higher by 10–15% compared with the population varieties, and later registered varieties had the yield higher even by 20% than the other varieties cultivated in the Czech Republic.

The authors paid their attention to the research of cultural practices and peculiarities of yield formation of hybrid varieties (Capouchová et al., 1998) and to technological quality of varieties (Petr et al., 1999). They proved the requirement for low sowing rates of 200–300 germinating seeds per 1 m^2, where greater productive shooting occurs and mainly higher productivity of spike (number of grains and grain weight). Experience from Germany where cultivation of hybrid varieties spread fast and brought total increase of rye production (Aufhammer, 1989) was confirmed. In the Czech Republic in recent years hybrid varieties have been spread and exceeded the areas sown by population varieties.

This study was aimed at verifying of production potential of rye hybrid varieties in ecological agriculture that is required on the market with biofoods.

In addition, they want to assess the reaction of both groups of varieties to intensity of cultivation and their response to different agroecological conditions.

MATERIAL AND METHOD

In the years 2001–2003 the authors studied the yields of winter rye hybrid and population varieties on four locations and two levels of intensity of cultivation. They compared the system of ecological agriculture. Experiments were performed on variety testing stations of the Central Institute for Supervising and Testing (ÚKZÚZ) at Hradec on Svitava, Lípa near Havlíčkův Brod, the Testing Station at Nechanice and Uhříněves where the same varieties were cultivated ecologically.

The Variety Testing Station at Hradec on Svitava is situated in potato-growing region at the altitude 450 m above sea level with average annual temperature of 6.5 °C and annual sum of precipitation is 625 mm. Production potential of soils is 67 points. The Testing Station Lípa is placed in cereal-growing region at the altitude 505 m with annual average of temperatures 7.7 °C and sum of precipitation is 632 mm. The Testing Station Nechanice is situated in the sugar beet-growing region at the altitude 235 m above sea level with annual average temperature 8.1 °C and sum of precipitation 616 mm. The production potential of soils is 71 points. The Testing Station Uhříněves, where trials in ecological agriculture were carried out, is placed at the altitude 295 m above sea level with the temperature 8.4 °C and with the sum of precipitation 575 mm, production potential of soils is 84 points.

Hybrid varieties Fernando (Lochow-Petkus), Picasso (Lochow-Petkus) and Rapid (Saaten-Union) were studied in the experiments. The Polish variety Dankowskie Nowe (Danko) and the Czech varieties produced by the company Selgen, i.e. Albedo and Selgo were used as the population varieties. The descriptions of cultural practices from different experimental sites are in Table 1.

RESULTS AND DISCUSSION

Yield results (Table 2) verify the truth of the hypothesis that hybrid varieties are more yielding than the population varieties. In Hradec on Svitava the yields of hybrid varieties were higher by 21% at intensity I and by 18% at intensity II. In Nechanice it was by 8% and 14%, in Lípa by 11% and 17%, and in ecological cultivation it was by 7%. At all experimental sites and under both cultivation intensities and under ecological cultivation it is a real predictance. Another hypothesis can be considered as the true – higher intensity of cultivation brings increased rye yields. In Hradec on Svitava yield with higher intensity was increased in hybrid varieties by 23% and in the population varieties by 26%. In Nechanice the yield of hybrid varieties was higher by 43% and in population varieties it was higher by 35%, in Lípa by 23% and by 17%.

Tables 3a, 3b show that hybrid varieties had higher yield increase under higher intensity compared with the population varieties. In Hradec on Svitava it was by 6%, in Nechanice by 31% and in Lípa by 50%, so it could be concluded that they more respond to intensive conditions. In ecological cultivation the yield differences among groups were lower than under intensive cultivation. Though the yields of hybrid varieties in ecological agriculture are higher than in population varieties, the differences among the years (except 2003) are small and with a lower variability. Hybrid varieties should be suitable for cultivation in ecological agriculture but the basic mixture should be cultivated in the ecological system.

Yield differences among hybrid varieties are insignificant in cultivation intensities I and II according to three years' means. The variety Picasso was dominant mong hybrid varieties by the yield on both levels of intensification inputs and the variety Fernando had the highest yield of all varieties in ecological cultivation. The variety Dankowskie Nowe was dominant among the population varieties, and in certain years also the variety Selgo. The variety Dankowskie Nowe was the most yielding in the population varieties.

In the Czech Republic growing regions are classified by their fertility. Experiments in this study were carried out in the sugar beet-growing region (Nechanice, Uhříněves), that is the most fertile region, followed by cereal-growing region (Lípa). The potato-growing region

Table 1. Summary of experimental conditions

Experimental site	Experimental year 2001	2002	2003
Hradec on Svitava	Forecrop – spring wheat	Forecrop – spring wheat	Forecrop – spring wheat
Intensity I	Sowing: 13. 9. 2000 Herbicide Stomp 330 EC 4 l/ha 14. 9. 2000 45 kg of N on 27. 3. 2001 45 kg of N on 4. 5. 2001	Sowing: 1. 10. 2001 Herbicide Stomp 330 EC 4 l/ha 2. 10. 2001 20 kg of N on 6. 3. 2002 20 kg of N on 27. 3. 2002 40 kg of N on 7. 5. 2002	Sowing: 20. 9. 2002 Herbicide Stomp 330 EC 4 l/ha 20. 9. 2002 40 kg of N on 18. 3. 2003 40 kg of N on 16. 5. 2003
Hradec on Svitava	Forecrop – spring wheat	Forecrop – spring wheat	Forecrop – spring wheat
Intensity II	Sowing: 13. 9. 2000 Herb. Stomp 330 EC 4 l/ha 14. 9. 2000 75 kg of N on 27. 3. 2001 45 kg of N on 4. 5. 2001 9. 5. 2001 Terpal C 2.2 l/ha + Tilt 250 EC 0.5 l/ha 31. 5. 2001 Tango Super 1.0 l/ha	Herb. Stomp 4 l/ha 2. 10. 2001 35 kg of N on 6. 3. 2002 35 kg of N on 27. 3. 2002 40 kg of N on 7. 5. 2002 7. 5. Terpal 2 l/ha + Duett 1.5 l/ha 28. 5. 2002 Tango Super 1.0 l/ha	Sowing: 20. 9. 2002 Herb. Stomp 330 EC 20. 9. 2002 70 kg of N on 18. 3. 2003 40 kg of N on 16. 5. 2003 16. 5. Terpal 2 l/ha + Duett 1.5 l/ha 12. 6. 2003 Tango Super 1.0 l/ha
Nechanice	Forecrop – field pea	Forecrop – field pea	Forecrop – field pea
Intensity I	Sowing: 28. 9. 2000 Herb. 23. 4. 2001 StaraneE C + MCPA Steffes 0.8 l/ha 50 kg of N on 7. 3. 2001 30 kg of N on 29. 4. 2001	Sowing: 30. 9. 2001 Herb. Glean 75 WC + MCPA Steffes 1 l/ha + Starane 250 EC 0.8 l/ha 8. 4. 2002 30 kg of N on 8. 3. 2002 30 kg of N on 26.4. 2002	Sowing: 30. 9. 2001 Herb. Glean 75 WC + MCPA Steffes 1 l/ha + Starane 250 EC 0.8 l/ha 8. 4. 2002 40 kg of N on 19. 3. 2003 50 kg of N on 20. 4. 2003
Nechanice	Forecrop – field pea	Forecrop – field pea	Forecrop – field pea
Intensity II	Sowing: 28. 9. 2000 Herb. 23. 4. 2001 StaraneE C + MCPA Steffes 0.8 l/ha Terpal 2 l/ha + Tilt 0.5 l 29. 4. 2001 Duett 1.5 l/ha 30. 5. 80 kg of N on 7. 3. 2001 30 kg of N on 23. 4. 2001	Sowing: 30. 9. 2001 Herb. Glean 75 WC+ MCPA Steffes 1 l/ha + Starane 250 EC 0.8 l/ha 8. 4. 2002 3. 5. 2002 Terpal 2 l/ha 7. 5. Duett 1.5 l/ha 23. 5. Tango Super 1 l/ha 50 kg of N on 8. 3. 2002 30 kg of N on 26. 4. 2002	Sowing: 30. 9. 2001 Herb. Glean 75 WC + MCPA Steffes 1 l/ha + Starane 250 EC0 8 l/ha 8. 4. 2002 5. 5. 2003 Terpal 2 l/ha 8. 5. 2003 Duett 1.5 l/ha 24. 5. Tango Super 1 l/ha 60 kg of N on 19. 3. 2003 50 kg of N on 20. 4. 2003
Lípa	Forecrop – red clover	Forecrop – red clover	Forecrop – red clover
Intensity I	Sowing: 20. 9. 2000 Herbicide 27. 9. 2000 Stomp 330 5 l/ha 30 kg of N on 28. 3. 2001 30 kg of N on 23. 4. 2001	Sowing 3. 10. 2001 Herbicide 4. 10. 2001 Stomp 330 5 l/ha 30 kg of N on 2. 4. 2002 30 kg N of on 3. 5. 2002	Sowing: 23. 9. 2002 Herbicide 24. 9. 2002 Stomp 330 5 l/ha 30 kg of N on 24. 3. 2003 30 kg of N on 30. 4. 2003
Lípa	Forecrop – red clover	Forecrop – red clover	Forecrop – red clover
Intensity II	Sowing: 20. 9. 2000 Herbicide 27. 9. 2000 Stomp 330 5 l/ha 45 kg of N on 28. 3. 2001 45 kg of N on 24. 4. 2001 4.5. Terpal 2 l + Tilt 0.5 l/ha 28. 5. Duett 1.5 l/ha	Sowing: 3. 10. 2001 Herbicide 4. 10. 2001 Stomp 330 5 l/ha 45 kg of N on 2. 4. 2002 45 kg of N on 3. 5. 2002 3.5. Duett 1.5 l/ha 4. 5. Tango Super 1 l/ha 7. 5. Terpal 1.7 l/ha 19. 6. 2002 Nurell 0.6 l	Sowing: 23. 9. 2002 Herbicide 24. 9. 2002 Stomp 330 5 l/ha 45 kg of N on 24. 3. 2003 45 kg of N on 30. 4. 2003 7. 5. 2003 Duett 1.5 l/ha + Terpal 2.0 l/ha 22. 5. 2003 Tango Super 1 l/ha
Uhříněves	Forecrop – red clover	Forecrop – red clover	Forecrop – red clover
Ecological system of cultivation	Sowing: 13. 10. 2000 Harrowing 24. 10. 2000 Harrowing 24. 3. 2001	Sowing: 8. 10. 2001 Harrowing: 16. 3. 2002 5. 4. 2002 10. 5. 2002	Sowing: 3. 10. 2003 Harrowing: 31. 3. 2004 28. 4. 2004 18. 5. 2004

Table 2. Winter rye yields of hybrid and population varieties – average for the years 2001–2003 from the testing stations Hradec nad Svitavou, Lípa and Nechanice

Year		2001	2002	2003	2004
Varieties	Intensity	t/ha	t/ha	t/ha	t/ha
Hybrid varieties	I	5.85	6.92	7.93	6.90
	II	8.46	8.68	9.63	7.92
Difference		2.61	1.76	1.70	2.02
Population varieties	I	4.84	6.09	7.09	6.00
	II	7.25	7.44	8.26	765
Difference		2.41	1.35	1.17	1.65
Difference in hybrid and population varieties	I	1.01	0.83	84	0.9
	II	1.21	1.24	1.37	1.27

(Hradec on Svitava) has even lower production potential. There is also a possibility to assess the rye yields also by their regions.

The rye varieties reached the highest yields in the potato-growing region in hybrid varieties as well as in population varieties. They were higher or almost identical as on more fertile soils – where sugar-beet and cereals are cultivated. At the same time, in the potato-growing region a cereal – spring wheat – was a forecrop, while legumes and clover were the forecrops in remaining regions. It can be explained by relatively small difference in production potential of soils. In Nechanice a value is 70 points and in Hradec on Svitava 67 it is points. However, this also confirms that rye is able to utilize better less fertile soils. The yield difference between ecological (without fertilization and pesticides) and intensive cultivation was increasing with the degree of intensity. The differences were greater in hybrid varieties compared with population varieties. When compared the yield within the beet-growing region (Nechanice and

Table 3a. Winter rye yields of hybrid and population varieties (t/ha)

Variety	Intensity	Hradec on Svitava				Nechanice			
		2001	2002	2003	Average	2001	2002	2003	Average
Hybrid varieties									
Fernando	I	6.98	8.14	7.41	7.51	5.29	5.70	8.91	6.63
	II	8.74	9.51	9.26	9.17	8.60	8.91	10.24	9.25
Picasso	I	6.95	8.31	7.72	7.66	4.86	5.40	8.93	6.39
	II	8.92	8.98	9.88	9.26	8.58	8.39	11.03	9.33
Rapid	I	6.55	8.36	7.50	7.47	3.98	6.00	8.34	6.10
	II	8.92	9.94	9.25	9.37	7.91	8.23	10.17	8.77
Average of hybrid varieties	I	6.82	8.27	7.54	7.54	4.71	5.70	8.72	6.37
	II	8.86	9.47	9.46	9.26	8.36	8.51	10.48	9.11
Difference in intensities I and II		2.04	1.20	1.92	1.72	3.65	2.81	1.76	2.74
Significant difference *P* 0.05	I	0.34	0.60	0.63		0.60	0.56	0.86	
	II	0.43	0.64	0.72		0.89	0.65	1.53	
Population varieties									
Dankowskie Nowe	I	5.64	6.74	6.20	6.19	4.08	5.60	8.01	5.89
	II	7.98	7.93	7.94	7.95	7.21	7.27	9.72	8.06
Selgo	I	5.86	6.94	6.59	6.46	4.34	5.53	7.81	5.89
	II	7.47	7.79	8.03	7.76	6.97	7.28	10.13	8.12
Albedo	I	5.55	6.75	5.90	6.06	3.63	5.22	8.64	5.83
	II	7.66	7.57	8.25	7.84	7.05	7.28	9.82	8.05
Average of population varieties	I	5.68	6.81	6.23	6.23	4.01	5.45	8.15	5.87
	II	7.70	7.76	8.08	7.85	7.24	7.44	9.19	7.95
Difference in intensities I and II		2.02	0.95	1.85	1.62	3.23	1.99	1.04	2.08
Significant difference	I	0.34	0.60	0.63		0.60	0.56	0.86	
	II	0.43	0.64	0.72		0.89	0.65	1.56	

Uhříněves), the yield difference was 0.5 t/ha in intensity I and 3.24 t/ha in intensity II. This difference was smaller in population varieties.

The effect of weather on the yields in different years (Tables 4a, 4b) is usually very significant and often plays a decisive role (Petr et al.; 1987, 1991). The highest yields were achieved in ecological cultivation in Uhříněves in 2001. In this vegetation period autumn had good temperatures and precipitation, good overwintering and spring was characterised by good temperatures. March was the only arid (13 mm of precipitation), but this was compensated by humid April (79 mm), suitable for shooting and establishment of productive spikes as it was proved earlier (Petr et al., 1984).

Normal temperatures and precipitation in May limited reduction of tillers and spikelets in spike. This weather pattern brought the yields almost 7 tonnes without fertilization and chemical protection of stands.

The year 2002–2003 was critical for the yield formation in Uhříněves. Autumn with normal temperatures was humid after stand establishment. Poor overwintering was followed by very arid spring (February, March, April), when plants were dying and had a few tillers. Unfavourable conditions persisted even after establishment of the basis of the spikes. Also May with normal precipitation did not contribute to improvement that could not cover the deficit from the previous months. Another unfavourable course of June (drought and heat) restricted the spike productivity and weight of caryopses what was manifested in substandard level of the yield in this year.

The weather conditions in Nechanice had a good effect on the yields in the year 2003 and unfavourable in the year 2001. Weather in autumn of 2000 was rather warm and a little dry. Similarly, the first months of 2001, January and February, were warm and dry. Not until March the abundance of precipitation was brought. April, too, was warmer and moister. However, May was critical for yield formation (dry and warm) and also June (substandard precipitation and colder). July was moister and warmer. Peculiarity of this year was a significant yield difference between cultivation intensities I and II in hybrid varieties when the yield was 3.65 tonnes and 3.23 tonnes/ha in population varieties. Abundant precipitation in March and April resulted in washing out of nitrogen from lower layers of soil and 80 kg of nitrogen applied on 7 March and 30 kg of N applied on 29 April had greater intensity had a very strong yield-forming effect, particularly for tilling and establishing of productive spikes, in the system II. It can also be contributed to the effect of growth regulator (Terpal). The principle of such high yields could be seen in both groups of varieties at cultivation intensity II. A possibility of unfavourable

Table 3b. Winter rye yields of hybrid and population varieties (t/ha)

Variety	Intensity	Lípa				Uhříněves EKO			
		2001	2002	2003	Average	2001	2002	2003	Average
Hybrid varieties									
Fernando	I	5.77	6.86	7.69	6.77				
	II	7.12	7.72	9.32	8.38	7.40	5.76	5.55	6.23
Picasso	I	6.31	6.88	7.62	6.93				
	II	8.36	7.83	9.31	8.50	6.88	6.11	2.82	5.26
Rapid	I	6.00	6.65	7.38	6.67				
	II	8.01	8.67	8.25	8.31	6.59	5.83	4.95	5.79
Average of hybrid varieties	I	6.02	6.79	7.55	6.79				
	II	8.16	8.05	8.96	8.39	6.95	5.90	4.44	5.76
Difference in intensities I and II		2.14	1.26	1.41	1.60				
Population varieties									
Dankowskie Nowe	I	5.64	6.74	6.20	6.34				
	II	7.98	7.93	7.94	7.05	6.02	6.06	4.97	5.68
Selgo	I	5.86	6.94	6.59	6.15				
	II	7.47	7.79	8.03	7.37	6.23	5.39	3.71	5.11
Albedo	I	5.13	5.59	6.70	5.80				
	II	6.94	6.72	7.49	7.05	6.37	5.59	4.09	5.35
Average of population varieties	I	5.36	6.03	6.90	6.09				
	II	6.81	7.13	7.53	7.15	6.20	5.68	4.25	5.38
Difference in intensities I and II		1.45	1.10	0.63	1.06				
Significant difference P 0.05	I	0.48	0.93	0.54					
	II	0.56	0.99	0.87					

Table 4a. Weather pattern in experimental years and sites

Testing Station Hradec on Svitava													
Months		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	∅ Σ
Long-term average	Temperatures	–3.2	–2.1	1.5	5.8	11.6	14.6	16.3	15.0	11.4	6.5	2.2	–1.2	6.5
	Precipitation	36	34	34	46	61	74	86	70	47	49	45	42	625
Year 2000	°C								19.9	14.2	11.6	6.1	1.73	10.7
	mm								40.2	33.1	62.3	30.6	12.9	179
Year 2001	°C	–2.7	–1.0	2.6	6.2	13.8	13.3	17.3	17.4	10.8	10.8	0.7	–5.3	7.0
	mm	45.4	23.1	57.1	44.5	63.1	77.5	168.8	116.1	76.4	29.9	41.1	40.2	783
Year 2002	°C	–2.2	2.6	3.4	6.9	15.4	16.7	18.5	18.2	11.1	6.0	4.5	–4.2	8.1
	mm	23.0	50.2	21.9	29.1	53.7	67.0	76.2	112.6	63.8	65.7	40.9	52.6	657
Year 2003	°C	–3.2	–5.9	2.1	6.3	15.0	18.8	17.7	19.0					8.7
	mm	36.8	10.0	7.6	31.0	116.2	10.9	88.8	17.8					319
Testing Station Lípa near Havlíčkův Brod														
Long-term average	Temperatures	–2.9	–1.4	2.7	6.6	12.3	15.3	17.6	17.3	13.3	8.4	2.6	–0.8	7.7
	Precipitation	41	30	39	41	68	83	79	80	44	39	46	41	632
Year 2000	°C									12.1	10.6	5.2	0.4	7.1
	mm									23.0	35.6	27.0	14.2	100
Year 2001	°C	–2.4	–0.3	3.1	6.5	13.8	13.7	16.1	17.9	10.4	11.2	1.3	–4.5	7.2
	mm	36.4	28.9	40.2	32.4	102.2	57.1	113.6	49.0	39.0	6.2	34.6	21.0	559
Year 2002	°C	–1.7	3.6	3.3	7.0	15.0	17.0	18.4	17.3	8.9	6.2	4.8	–2.0	8.1
	mm	24.8	42.6	27.2	22.4	29.0	58.2	43.0	169.6	21.2	80.6	83.9	33.6	530
Year 2003	°C	–2.7	–5.3	3.9	7.9	14.7	18.8	17.7	19.9					9.3
	mm	38.4	3.2	7.0	13.8	92.2	23.6	63.8	30.4					272

weather elimination by intensification inputs could be concluded from the results achieved. However, it cannot be generalised because it is always bound to certain weather conditions.

Weather in the year 2002–2003 was described several times, always for different location, so some characteristics of this year could be the same, but others are different. The autumn in Nechanice was very moist, precipitation in October reached 174%, in November it was 156% and in December 118% of long-term normal. This was not good for strengthening of plants, but rye overcome the period of low temperatures – even below 16 °C. Temperatures in January fell below –20 °C and precipitation was abnormal. Further months (February, March, April) were dry, however had still a great number of extremely cold days and minimal temperatures below –10° C to –12 °C. Damage to plants caused by frost was not very high and warm and moist May contributed to reached average yields (150% of normal of precipitation). Good weather continued in June and July. Abnormal yields were obtained at higher intensity, where higher nitrogen rates and protection against leaf diseases were applied. The yield consisted mainly in the spike productivity (number of caryopses and their weight).

Autumn of 2001 in Hradec nad Svitavou was from summer moist, with normal temperatures. December – very cold, with frosts –17 °C to –19 °C. Spring months of 2002 had normal temperatures and were slightly warm and dry (except February). April, May and June were rather good for stand productivity (number of spikes) as well as for spike productivity (number and weight of caryopses). This affected significantly relatively high yield level reached in this year, particularly in hybrid varieties.

The highest yields were achieved in the experimental year 2002–2003 in Hradec on Svitava. This year was special by its pattern and in particular by bad overwintering of winter wheat, rape, barley and triticale. However, average to abnormal rye yields were recorded. Autumn was moist with normal precipitation like in some other sites, but was characterised by very early start of frost in October (10 freezing days), in November (17 freezing days) and mainly in December (29 freezing days), where minimal temperatures fell below –17 °C. Temperatures in January were normal, February was characterized by frosts with minimum temperatures below –19 °C. March and April were warmer and relatively dry. May that was rich in precipitation (190% of long-term average) had a great influence on a good yield. In further months the weather did not affect unfavourably established yield components (number of grains and weight of caryopses).

The year 2002–2003 belonged to most yielding also in the cereal-growing region, as it could be seen from experiments carried out in Lípa near Havlíčkův Brod. The pattern of autumn was different than in majority of the territory, very moist October and November. Frosts in December below –14 °C, temperatures were similar in

Table 4b. Weather pattern in experimental years and sites

Testing Station Uhříněves													
Months		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	∅ Σ
Long-term average	Temperatures	–2.1	–0.8	3.4	8.2	13.4	16.3	18.2	17.5	14.0	8.6	3.2	–0.5	8.3
	Precipitation	28	27	31	46	65	74	74	72	49	41	34	34	575
Year 2000	°C								19.9	14.2	11.6	6.1	1.73	10.7
	mm								40.2	33.1	62.3	30.6	12.9	179
Year 2001	°C	–0.4	2.4	5.2	8.5	15.6	15.5	18.9	19.5	12.4	12.5	2.9	–1.36	9.4
	mm	25.4	30.9	13.0	71.6	67.3	71.9	97.5	71.5	75.0	22.4	41.2	49.2	637
Year 2002	°C	0.8	5.0	5.5	9.1	16.5	18.6	19.5	19.8	13.2	8.4	5.2	–1.37	10.0
	mm	19.6	56.1	31.7	26.5	50.1	132.7	113.9	226.5	73.7	59.2	82.7	50.4	923
Year 2003	°C	–0.6	–2.7	5.4	9.0	16.5	20.9	20.0						9.7
	mm	29.4	5.3	7.9	22.0	72.8	30.9	76.0						244
Testing Station Nechanice														
Long-term average	Temperatures	–2.3	–1.2	3.0	7.8	13.3	16.3	18.0	17.2	13.3	8.1	3.4	–0.3	8.1
	Precipitation	38	35	36	39	65	69	80	72	45	49	40	48	616
Year 2000	°C									13.8	12.3	6.6	1.5	8.5
	mm									31.3	34.5	38.3	19.9	124
Year 2001	°C	–0.5	0.8	4.1	8.2	15.6	15.2	19.1	19.5	12.2	12.4	2.1	–3.0	8.8
	mm	29.9	23.8	62.1	59.6	39.2	54.8	116.8	101.1	108.0	24.0	66.8	51.6	738
Year 2002	°C	–1.0	4.2	5.3	8.6	17.6	18.8	19.4	20.4	13.2	7.8	5.6	–2.9	9.7
	mm	31.9	78.1	20.3	35.6	25.9	43.5	64.3	199.7	38.2	85.4	62.5	56.5	618
Year 2003	°C	–1.6	–3.6	4.4	8.4	16.3	20.8	19.7						9.2
	mm	48.3	15.9	12.4	21.7	97.3	34.3	58.2						288

January 2003. However, February was very cold and dry, minimal temperatures were below –18 °C. Following months were warmer but dry. May that was characterised by abundance of precipitation contributed again to a good yield that made a contribution to the spike productivity that was subsequently only a little reduced, by its good weather resembling to June and July. Support of fertilization and protection used in intensity of cultivation II should be added to it.

Winter conditions of the year 2002–2003 are considered the most critical for overwintering what was somewhere manifested by a great damage to some wheat varieties when 21% of the total sown area was ploughed in (2003) in the Czech Republic, 29% of winter barley, 7.5% of triticale and 29% of winter rape. In rye where only 3% of the sown area was ploughed in, high resistance to frost and winter conditions was proved, so the yields, too, were average. Warmer and rainy May and further weather in June and July contributed to a good yield. The yield was formed prevailingly by spike productivity – the number of caryopses and their weight what was reported earlier – Capouchová et al. (1998).

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PETR, J. (Česká zemědělská univerzita, Fakulta agrobiologie, potravinových a přírodních zdrojů, Praha, Česká republika):

Výnosový potenciál žita, odrůd hybridů a populace, v ekologickém a intenzivním pěstování.

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V tříletých pokusech jsme sledovali výnos ozimého žita, odrůd hybridů a populace na čtyřech lokalitách a na dvou úrovních intenzity pěstování a v ekologickém zemědělství. První úroveň intenzity měla mořené osivo, herbicid a základní hnojení dusíkem, ve druhé intenzitě bylo vedle mořeného osiva a herbicidu použito vyšší hnojení dusíkem a byl aplikován fungicid, insekticid a regulátor růstu. Ekologický způsob byl veden v certifikovaných podmínkách podle vyhlášky MZe ČR č. 242/2000 Sb. a mezinárodních předpisů IFOAM.

Potvrdila se vyšší výnosnost ozimého žita odrůd hybridů oproti odrůdám populace ve sledovaných pěstitelských oblastech a také v ekologickém zemědělství.

Vyšší intenzita pěstování přinesla zvýšení výnosů u obou skupin odrůd, ale odrůdy hybridů měly při ní vyšší přírůstek výnosů než odrůdy populace. Odrůdy hybridů více reagovaly na zvýšenou intenzitu.

V ekologickém zemědělství byly také výnosnější odrůdy hybridů, ale výnosové rozdíly mezi odrůdami hybridů a populace byly menší než v intenzivních podmínkách. Rozdíly mezi odrůdami v obou skupinách nebyly statisticky průkazné.

Žito (odrůdy hybridů i populace) se ukázalo jako vhodná obilnina pro ekologické zemědělství. U odrůd hybridů by se však musela základní směs komponentů pěstovat také v ekologických podmínkách.

Mezi odrůdami hybridů nebyly u I. a II. intenzity pěstování výnosové rozdíly statisticky průkazné. Mezi odrůdami populace při nižší intenzitě byla výnosnější odrůda Dankowskie Nowe, v některých letech i Selgo.

Při hodnocení výnosů v jednotlivých výrobních oblastech se potvrdilo, že žito lépe využívá méně úrodných podmínek.

Počasí v jednotlivých letech i lokalitách mělo rozhodující vliv na úroveň výnosů. Podrobná analýza ukázala, že rozhodující vliv měl průběh počasí v dubnu a v květnu, kdy v letech s dostatkem srážek a spíše chladnějším počasím byly nejvyšší výnosy. Za takových podmínek se založí větší počet silných, většinou plodných odnoží a také vyšší potenciální produktivita klasu.V dubnu se formuje počet klásků a kvítků, a tím i potenciální počet zrn v klasu.

U hybridních odrůd je výnos tvořen převážně produktivitou klasu. Jeho produktivita je dána také větší listovou plochou připadající na jeden založený kvítek (Capouchová et al., 1998).

Do období pokusu zasáhla mimořádně nepříznivá zima 2002–2003. Potvrdila se vysoká mrazuvzdornost žita a obecná odolnost zimním podmínkám, a to u obou skupin odrůd.

Počasí zasáhlo i do výživy dusíkem. To se projevilo v roce 2000–2001, kdy vlivem velkých srážek se vyplavil dusík. Vyšší regenerační dávka v II. intenzitě pěstování pomohla tento deficit překonat, což přineslo velmi vysoký výnosový přírůstek.

žito; výnosy odrůd hybridů a populace; ekologické a intenzivní pěstování

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