Rye *(Secale cereale L.)*

French: Seigle; Spanish: Centeno; Italian: Segale; German: Roggen

Crop data

Annual, with autumn-sown (winter rye) and, rarely, due to low yields, spring-sown types.

Harvestable products: grain, straw and whole green plant

Desired characteristics affecting fertilizer requirements:

In grain for flour - high swelling ability of starch, high amylopectin, absence of sprouting. In grain for malting (for beer-making) - high starch, low crude protein, absence of sprouting. In grain for alcohol - high starch, low crude protein. In grain for animal feed (as coarse meal) - high crude protein, especially lysine.

Straw for bedding - dry absorbent material. Straw for cellulose and pasteboard - high cellulose, low lignin and ash. Straw for constructional insulation - dry mass, low bulk density.

Green plant for forage - high cellulose, low lignin and ash. Green plant for silage - high content of easily soluble carbohydrates.

Rye used for animal feed is best grown as a companion crop to a legume.

Varieties - those with open pollination are not very uniform; they can adapt themselves to poor soils, even to quite acid soils. Their resistance to lodging is too low for high yields; some improvement is achieved with tetraploid forms. So called 'hybrid varieties' (the correct breeding term should be 'synbrid') brought great progress in yield and lodging resistance and they can be as demanding as wheat. Triticale (hybrids of wheat and rye) tend to be a good compromise between wheat and rye. Winter rye has the advantage of producing a good growth in the autumn and so, with a better soil cover, reduces the risk of erosion and unproductive evaporation.

Sowing time - Winter rye should be sown sufficiently early to have at least three weeks for tillering before the winter rest period starts. Spring rye should be sown as soon as temperature and water supply permit.

Temperature limitations and the duration of the various growth periods are illustrated in the following table:

Growth stages and climatic limitations in the development of rye							
Stage	**EC[1)]**	**Duration (days)**		**Temperature (°C)**			**Dayleng th (h/d)**
		Winter rye	**Spring rye**	**min**	**opt.**	**max**	
Sowing and germination	0.1-0.9	7	7	1-2	25-30	30-37	
Seedling emergence and early growth	1.0-1.9	11	11	3-5			
Tillering, initiation of ear primordia	2.0-2.9	38[2)]	38		5		
Beginning of stem elongation and formation of ear primordia	3.0-3.9	18	19				> 12-14 ¦
Flag leaf, floret reduction, booting	4.0-4.9	12	12				
Ear emergence	5.0-5.9	9	7				
Flowering and grain initiation	6.0-6.9	21	20				
Grain formation	7.0-7.9	27	25		> 15		
Maturing of the grain	8.0-9.2	20	21				
Total		163[2)]	160		1 700-2 400[3)]		
1) EC = Eucarpia Scale; 2) To be added: duration of vegetative rest (depending on location; e.g.: 134 days); 3) Total daily temperatures above 0° C (temperatures below 0° C deducted).							
Source: Aigner et al., 1988; modified							

The following table shows the changes in yield components relative to the amount of plant available precipitation. It should be noted that varieties differ in their water requirements and in harvest indices (i.e. proportions of grain in the total biomass at harvest, in terms of dry weight), so some adaptation of the table may be needed. Also, yields of ears from third-order tillers are only a little lower than those of ears from the main stem of first-order tillers, with the result that more intensive tillering is desirable than, for example, in wheat.

Yield structure of rye as function of plant available precipitation*							
	Plant available precipitation						
	150 mm	**250 mm**	**350 mm**	**450 mm**	**550 mm**	**650 mm**	**750 mm**
Grain yield	20	32	68	100 = 5.9 t/ha	119	127	131
Ear density	44	67	89	100 = 450/m2	111	120	129
Single ear weight	46	48	76	100 = 1.31 g	107	106	101
Optimal number of ears per plant = 2-3							
* Relative to 450 mm available precipitation; Plant available precipitation = amount solely available for crop growth, i.e. excluding evaporation, runoff, drainage and other losses.							
Source: various experimental results							

Nutrient demand/uptake/removal

Nutrient uptake/removal of winter rye- Macronutrients				
Yield base	t/ha	kg/ha		
		N	**P2O5**	**K2O**
Biomass: (DM)	11.9	133	46	180
Grain:	5.9	87	35	36
Source: various experimental results				

Relative nutrient uptake of winter rye in relation to plant development				
Stage	**N**	**P2O5**	**K2O**	**Dry matter**
	per cent of maximum			
Early growth	0	0	0	1
Tillering	26	20	15	6
Jointing	35	30	24	10
Booting	49	46	42	26
Ear emergence	71	74	87	44
Flowering	81	96	100	78
Grain formation	94	98	97	100
Physiological maturity				
- Biomass	100	100	92	84
- Grain	65	76	20	49
Maximum (100 %)	**kg/ha**			
- Biomass	133	46	180	11 900
- Grain only	87	35	36	5 900
Source: Aigner et al., 1988				

Fertilizer recommendations

In general the same principles apply to rye and its crosses as to wheat but the level of nutrients needed varies considerably.

A recommendation for winter rye with an expected yield of 6 t/ha grain would be 120 kg/ha N, 120 kg/ha P2O5, 100 kg/ha K2O, with an additional 5 - 20 kg/ha N in minimum tillage systems. Attention needs to be given to the risk of lodging, which is greater than with wheat and is more difficult to prevent, due to the lack of appropriate breeding and because growth regulators do not work so well on rye. On poor soils and in succession to a crop which has received little fertilizer, some application of fertilizer in autumn is recommended. A smaller late application is needed than for other temperate cereals. On the other hand, if all the N is given in a single dressing, or if slurry is applied, then some loss of N must be expected.

Further reading

FORSBERG, R.A.: Triticale. CSSA Special Publication 9, Madison, WI, USA (1985)

REINER, L. et al.: Winterroggen aktuell. DLG-Verlag, Frankfurt a.M., Germany (1979)

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