Oats *(Avena sativa L.)*

French: Avoine; Spanish: Avena; Italian: Avena; German: Hafer

Crop data

Annual, with autumn-sown (winter oats, in areas with mild winters) and spring-sown types.

Harvestable products: grain, straw and whole green plant.

Desired characteristics affecting fertilizer requirement:

In grain for flour or coarse meal for human consumption: high starch, protein and fat, absence of sprouting, no glumes. In grain for animal feed: high crude protein, low proportion of glumes.

Straw for animal feed: high cellulose, low lignin and ash. Straw for bedding: dry absorbent material.

Green plant for forage: high crude protein and energy contents. Green plant for silage: high content of easily soluble carbohydrates.

Oats for animal feed are preferably grown as mixed or dredge corn.

Varieties differ in water requirement, liability to micronutrient deficiency (particularly of Mn), disease resistance and proportion of glumes in the grain. The risk of lodging is greater than with wheat, especially because the use of plant growth regulators is not as safe as with wheat or barley.

Sowing time: Spring oats should be sown as early as possible at the beginning of the growing period. Winter oats should be sown sufficiently early to have at least three weeks for tillering before the onset of the vegetative rest period.

Seeding rate: for an expected yield of 5 t/ha grain, good conditions for emergence and varieties with high single panicle yield, 400 grains/m^2 are recommended.

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

Growth stages and climatic limitations in the development of spring oats					
Stage	**EC[1)]**	**Duration (days)**	**Temperature (°C)**		
			min.	**opt.**	**max.**
Sowing and germination	0.1-0.9	13	3 - 5	25-30	30-37
Emergence and early growth	1.0-1.9	12			
Tillering, initiation of ear primordia	2.0-2.9	19	> -10[2)]	5	
Beginning of stem elongation, forming of ear primordia	3.0-3.9	19			
Flag leaf, floret reduction, booting	4.0-4.9	15			
Ear emergence	5.0-5.9	36			
Flowering and grain initiation	6.0-6.9	8	> 12	15-16	
Grain formation	7.0-7.9	40			
Maturing of the grain	8.0-9.2	5			
Total		167		2 100[3)]	
1) EC = Eucarpia Scale 2) Winter oats 3) Total daily temperatures above 0° C (temperatures below 0° C deducted)					
Source: Aigner et al., 1988; modified					

The next table shows the change 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).

Yield structure of oats as function of plant available precipitation *					
	Plant available precipitation				
	350 mm	**450 mm**	**550 mm**	**650 mm**	**750 mm**
Grain yield	30	60	100 = 5.0 t/ha	120	138
Ear density	74	86	100 = 350/m2	114	120
Single ear weight	40	70	100 = 1.43 g	105	115
Optimal number of ears per plant = 1.5-2					
* Relative to 550 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					

For spring oats the management of plant density should be similar to that of spring wheat (see “ wheat ”). For winter oats the management of plant density is similar to that of winter rye (see “ rye ”).

Nutrient demand/uptake/removal

Nutrient uptake/removal - Macronutrients				
Yield base	t/ha	kg/ha		
		N	**P2O5**	**K2O**
Biomass*: (DM)	9.8	134	50	235
Grain:	5.0	99	32	43
* Whole above-ground portion of plant				
Source: various experimental results				

Relative nutrient uptake of oats in relation to plant development				
Stage	**N**	**P2O5**	**K2O**	**Dry matter**
	per cent of maximum			
Early growth	0	0	0	1
Tillering	16	10	11	4
Jointing	31	14	19	13
Booting	34	20	31	33
Ear emergence	68	60	88	55
Flowering	85	74	100	77
Grain formation	97	100	98	100
Physiological maturity				
- Biomass(dry)	100	100	94	95
- Grain	74	64	18	51
Maximum (100 %)	**kg/ha**			
- Whole plant	134	50	235	9 800
- Grain only	99	32	43	5 000
Source: Aigner et al., 1988				

Fertilizer recommendations

The amount of nutrients to be applied depends on the expected yield. For a target of 3.5 t/ha an amount of 70 kg/ha N, 35 kg/ha P2O5 and 105 kg/ha K2O is needed. These figures depend on the location.

On sandy soils the extensive root system largely prevents loss of N by leaching and the available nutrients are much better utilized than, for example, by wheat. In areas where high yields (5 - 6t/ha) are possible, it is common to use a total of 11O kg/ha N minus N_{min}, including at least 40 kg/ha N in spring plus a late N application at booting of the panicles.

Since the crop needs 200 g Mn/t grain, adequate Mn is of special importance (apply 0.6 kg $MnSO_4$ per ton of grain = 1.9 kg/ha for the target yield of 3.5 t/ha, where required. For Cu deficiency, 50 - 100 g/ha copper sulphate should be applied; and for Mo deficiency, 0.8 kg/ha sodium molybdate. However, excess of Ni, Cu, Co, Mo or Zn may cause leaf chlorosis.

Further reading

COFFMAN, F.A. (ed.): Oats and Oats Improvement. American Society of Agronomy, Madison, WI, USA (1961)

Authors: K.-U. Heyland, A. Werner; Lehrstuhl fuer Speziellen Pflanzenbau und Pflanzenzuechtung, University Bonn, Germany