

PHAEOZEMS (PH)

The Reference Soil Group of the Phaeozems accommodates soils of wet and warm steppe (prairie) regions. Phaeozems are much like [Chernozems](#) and [Kastanozems](#) but are more intensively leached in wet seasons. Consequently, they have dark, humous surface soils that, in comparison to Chernozems and Kastanozems, are less rich in bases and Phaeozems have no (signs of) secondary carbonates in the upper metre of soil. Commonly used international names are 'Brunizems' (Argentina, France), 'Degraded Chernozems' (former USSR), 'Parabraunerde-Tsjernozems' (Germany), 'Dusky red prairie soils' (USA) or 'Udolls' and 'Aquolls' in the order of the Mollisols (USDA Soil Taxonomy).

Definition of Phaeozems

Soils having

- 1 a [mollic](#) horizon, **and**
- 2 a base saturation (in 1 M NH₄OAc at pH 7.0) of 50 percent or more and having no secondary carbonates to at least a depth of 100 cm from the soil surface, or to a contrastig layer ([lithic](#) or [paralithic](#) contact, [petrocalcic](#) horizon) between 25 and 100 cm; **and**
- 3 no diagnostic horizons other than an [albic](#), [argic](#), [cambic](#) or [vertic](#) horizon.

Common soil units:

[Chernic](#), [Leptic](#), [Vertic](#), [Gleyic](#), [Vitric](#), [Andic](#), [Luvic](#), [Tephric](#), [Stagnic](#), [Abruptic](#), [Greyic](#), [Pachic](#), [Glossic](#), [Calcaric](#), [Albic](#), [Skeletal](#), [Sodic](#), [Siltic](#), [Vermic](#), [Dystric](#), [Chromic](#), [Haplic](#).

Summary description of Phaeozems

Connotation: dark soils rich in organic matter; from Gr. phaios, dusky, and R. zemlja, earth, land.

Parent material: eolian (loess), glacial till and other unconsolidated, predominantly basic materials.

Environment: flat to undulating land in warm to cool (e.g. tropical highland) regions, humid enough that there is, in most years, some percolation of the soil, but also with periods in which the soil dries out. The natural vegetation is tall grass steppe and/or forest.

Profile development: mostly AhBC-profiles with a mollic surface horizon (thinner and somewhat less dark than in Chernozems) over a cambic or argic subsurface horizon.

Use: Untouched Phaeozems (of which there are few left) carry a grass or forest vegetation. Phaeozems are fertile soils; they are planted to irrigated cereals and pulses or are used for cattle rearing and fattening on improved pastures. Periodic drought and wind and water erosion are the main limitations.

Regional distribution of Phaeozems

Phaeozems cover an estimated 190 million hectares worldwide. Some 70 million hectares of Phaeozems are found in the (sub-)humid Central Lowlands and easternmost parts of the Great Plains of the USA. Another 50 million hectares of Phaeozems are in the subtropical pampas of Argentina and Uruguay and the third largest distribution area of Phaeozems (18 million hectares) is in northeastern China. Smaller, mostly discontinuous areas, are found in Central Europe, notably the Danube area of Hungary and adjacent parts of Yugoslavia and in montane areas in the tropics. Figure 1 presents the main Phaeozem areas.

 Dominant  Associated  Inclusions  Miscellaneous lands

Figure 1. Phaeozems worldwide.

Associations with other Reference Soil Groups

Phaeozems occur in steppe to forest-steppe or forest-prairie areas that border on the humid side of the [Chernozem](#) belt in the temperate climatic zone and of the [Kastanozem](#) belt in the subtropics. Phaeozems north of the Eurasian and North American Chernozems occur in association with [Albeluvisols](#); they may even feature uncoated silt and sand grains on structural ped surfaces. South American Phaeozems are associated with [Planosols](#), [Solonchaks](#) and Kastanozems.

Genesis of Phaeozems

Phaeozems occur on fine-textured, basic parent material in more humid environments than [Chernozems](#) or [Kastanozems](#). The rates of weathering and leaching of bases are higher in Phaeozems than in Chernozems and Kastanozems. Calcium carbonate is absent from the upper metre of the soil profile but leaching is not so intense that the soils have become depleted of bases and/or plant nutrients. Biomass production and faunal activity are high; earthworms and burrowing mammals homogenize the soil. In places, the faunal activity is so intense that the [mollic](#) A-horizon is thickened and wormholes and krotovinas extend into the C-horizon.

Phaeozem formation appears to be conditioned by the annual precipitation surplus (which infiltrates into the soil). The North American Phaeozem belt extends from Canada, with an annual precipitation sum of only 400 mm and an average temperature of 2 °C, to Missouri in the south, with 1200 mm rainfall/year and an average temperature of 18 °C. The precipitation *surplus* over the (temperature-dependent) evapotranspiration is about the same from north to south, despite the considerable increase in the precipitation sum.

[Argic](#) B-horizons do occur in Phaeozems, but they are widely regarded as relics from an earlier development towards [Luvisols](#) (in eras with a more humid climate).

Characteristics of Phaeozems

Morphological characteristics

Phaeozems have a brown to grey, [mollic](#) A-horizon of 30-50 cm over a brown cambic horizon or a yellowish brown C-horizon, or over a brown or reddish brown [argic](#) horizon. The A-horizons of Phaeozems are thinner than of [Chernozems](#) and somewhat less dark. Where the water table is at shallow depth or a perched water table occurs (e.g. on top of an argic horizon), the surface soil may be mottled and/or dark. [Luvic](#) soil units, polygenetic or not, represent a more advanced stage of soil formation and have often more reddish colours than other Phaeozems.

Hydrological characteristics


Phaeozems with clay accumulation have even better water storage properties than other Phaeozems but may still be short of water in the dry season.

Physical characteristics

Phaeozems are porous, well aerated soils with moderate to strong, very stable, crumb to blocky structures. Where clay illuviation occurs, the illuviation layer contains commonly 10-20 percent more clay than the overlying horizon.

Chemical characteristics

The organic matter content of the surface layer of Phaeozems is typically around 5 percent; the C/N-ratio of the organic matter is 10-12; pH-values are between 5 and 7 and increase towards the C-horizon. The Cation Exchange Capacity of Phaeozems is 25-30 cmol(+) per kg dry soil or somewhat less; the base saturation percentage lies between 65 and 100 percent, with the highest values in the deeper subsoil.



Management and use of Phaeozems

Phaeozems are porous, fertile soils and make excellent farmland. In the USA and Argentina, Phaeozems are in use for the production of soybean and wheat (and other small grains). Phaeozems on the High Plains of Texas produce good yields of irrigated cotton. Phaeozems in the temperate climatic belt are planted to wheat, barley and vegetables alongside other crops. Wind and water erosion are serious hazards. Vast areas of Phaeozems are used for cattle rearing and fattening on improved pastures.