Amaranthus tricolor L.

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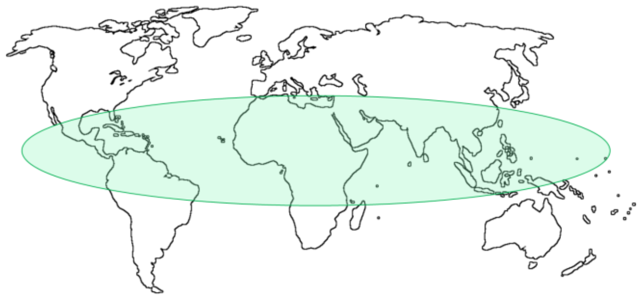
Photo:T.Slotta,
USDA-NRCS PLANTS Database

Origin and diffusion

Origin: Tropical Asia
Distribution: tropics
Invasive potential: low



Introduction

Amaranth is a rapidly-growing annual shrub, noted for its brilliantly coloured foliage and often used as ornamental plant. Being a C4 plant cycle, it has the ability to open the stomata to a lesser extent compared to plants with C3 cycle; this means that it is adapted to different climates, but lives optimally in tropical regions. The leaves and the stems may be eaten as a salad vegetable.

Common names: Joseph's Coat Amaranth, Fountain Plant, Love-Lies-Bleeding (English), Amaranto tricolore (Italian)

Description

Life-form and periodicity: annual shrub

Height: 50 cm – 1 m

Roots habit: The plant forms a strongly branched tap root

Culm/Stem/Trunk: elongated stem, green or reddish

Crown: -

Leaf: the leaves are alternate and simple. Ovate shape with undulate margin and pinnate venation. The foliage is red, yellow and green.

Fam. *Amaranthaceae*

Description

Rate of transpiration: -

Reproductive structure: The flowers are monoecious, individual flowers are either male or female; both sexes can be found on the same plant.

Propagative structure: : the fruit is an achene containing a small reticulated seed, shiny brown

Development

Sexual propagation: by seed which germinates readily. Pollination by wind

Asexual propagation: no entries found

Growth rate: fast

Habitat characteristics

Light and water requirement: plants prefer full sun and moist soil. Full sun enhances leaf colours.

Soil requirements: suitable for light (sandy), medium (loamy) and heavy (clay) soils; it prefers well-drained soil. Plants should be subjected to a moderate fertilization for best leaf colour.

Tolerance/sensitivity: : the plant can tolerate partial shade in the hottest locations and is quite drought-tolerant. It can grow in very acid soils.

Phytotechnologies applications

Several authors found that amaranth cultivars can tolerate elevated levels of **radionuclides** as Caesium, accumulating them to unusually high levels; those plants can be used as hyperaccumulators to restore the economic value of radionuclide contaminated land (Slavik *et al*.,1999; Tang, 2003). *Amaranthus* can also promote microbial biodegradation of **polycyclic aromatic hydrocarbons (PAHs)** in soil (Ling *et al*., 2004; Gao *et al*., 2006). *A. tricolor* has been suggested by Watanabe *et al*. (2009) as a useful plant for phytoremediation of **Cadmium** contaminated fields, due to the high accumulating ability showed for Cd, its large biomass production and its high growth rate.

Experimental studies

Reference	Ling, W., & Gao, Y. (2004). Promoted dissipation of phenanthrene and pyrene in soils by amaranth (Amaranthus tricolor L.). Environmental Geology, 46(5), 553-560.
Contaminants of concern	Phenantrene and pyrene (polycyclic aromatic hydrocarbons, PAHs)
Mechanism involved in phytoremediation: Phytostabilisation/rhizodegradation/phytoaccumulation/phytodegradation/phytovolatilization/ hydraulic control/ tolerant	Mostly rhizodegradation. Phytoaccumulation only accounted for less than 0.32% (for phenanthrene) and 0.33% (for pyrene) of the total amount.
Types of microorganisms associated with the plant	Nitrogen-fixing bacteria
Requirements for phytoremediation (specific nutrients, addition of oxygen)	The pots were watered as needed and fertilized every two weeks with an inorganic salt solution
Laboratory/field experiment	Laboratory experiment (greenhouse)
Soil characteristics	Soil samples were taken from a PAH-free soil. The soils had a pH of 5.05 and an organic matter of 1.45%. The soil was then spiked with a mixture of phenanthrene and pyrene.
Length of experiment	45 days
Age of plant at 1st exposure (seed, post-germination, mature)	Pregerminated seeds
Initial contaminant concentration of the substrate	Initial phenanthrene concentrations: 7.450–456.5 mg/kg DW and pyrene concentratins: 8.010–488.7 mg/kg DW.

Phytotechnologies applications

Post-experiment contaminant concentration of the substrate	At the end of the experiment (45 days), the loss of phenanthrene and pyrene in spiked soils with A. tricolor was 87.85–94.03 and 46.89–76.57% of the soil with these chemicals, which were 2.55–13.66% and 11.12–56.55% larger than the loss in soils with no A. tricolor , respectively.
Post-experiment plant condition	The root and shoot biomass tended to decrease with the increase of soil phenanthrene and pyrene concentrations. A. tricolor. formed a dense root system with all soils, irrespective of treatment.
Contaminant storage sites in the plant and contaminant concentrations in tissues (root, shoot, leaves, no storage)	BCFs of phenanthrene by roots of Amaranthus tricolor L. were 0.136–0.776, close to BCFs of phenanthrene by shoots (0.116–0.951) for the same treatment. BCFs of pyrene by roots were 0.603–1.425, much higher than BCFs of pyrene by shoots (0.082–0.517). Generally, BCFs of phenanthrene or pyrene tended to decrease with the soil concentrations of these chemicals

Reference	Watanabe T., Yasutoshi M., Osaki M., 2009. Amaranthus tricolor has the potential for phytoremediation of Cd-contaminated soils. Communications in Soil Science and Plant Analysis.	
Contaminants of concern	Cd	
Laboratory/field experiment	Water culture experiment	Soil culture experiment (greenhouse)
Mechanism involved in phytoremediation: Phytostabilisation/rhizodegradation/phytoaccumulation/phytodegradation/phytovolatilization/ hydraulic control/ tolerant	Phytoaccumulation	Phytoaccumulation
Types of microorganisms associated with the plant	Not reported in the publication	Not reported in the publication
Requirements for phytoremediation (specific nutrients, addition of oxygen)	After preculture, the plants were transplanted to 1.5-L pots containing the treatment solution, which was continuously aerated (two plants per pot).	Any specific requirement

Phytotechnologies applications

Soil characteristics	The treatment solution contained the standard nutrient solution with or without 10 µM Cd (cadmium chloride; $CdCl_2$). The pH of the solutions was adjusted to 5.5 with sodium hydroxide (NaOH) or hydrochloric acid (HCl) every day, and the solutions were renewed every week.	Brown lowland soil, pH (H_2O)= 6.5 was spiked with $CdCl_2$.
Length of experiment	2 weeks	30 days
Age of plant at 1st exposure (seed, post-germination, mature)	30 days old plantlet	Seed
Initial contaminant concentration of the substrate	10 µM Cd	10 mg/Kg Cd.
Post-experiment contaminant concentration of the substrate	Not reported in the publication	Not reported in the publication
Post-experiment plant condition	10 µM of Cd did not significantly inhibit the growth plants	Growth of A. tricolor was enhanced by Cd application; This may be due to the Cd-induced changes in physicochemical characteristics of soils.
Contaminant storage sites in the plant and contaminant concentrations in tissues (root, shoot, leaves, no storage)	Cd concentration in shoots : 100-150 mg/kg ; Cd concentration in roots: 250-400 mg/kg.	Cd concentration in shoots: 60-80 mg/kg.