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Morphology and Biology of Amaranth (Amaranthus cruentus L.) Plant in Soil Conditions of Andijan Region

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Abstract: the article provides valuable information about the morphology and biology of the amaranth (Amaranthus cruentus L.) plant in the soil conditions of Andijan region.

Keywords: morphology, biology, plant, amaranth, crop.

Origin

The centre of origin of Amaranthus is believed to be Central America, with evidence of its cultivation dating back as far as 6700 BC [1,2]. The Aztec civilization of central Mexico represents the first recorded instance of Amaranthus use, and the crop figured prominently in Aztec culture during the 1400 to 1500 AD. Amaranthus, which the Aztecs called 'huautli' was their staple food and was incorporated into their religious ceremonies. Its seeds were ground by Aztec women and mixed with honey, other sweets, and sometimes with human blood [3], then molded into various forms (including animals, natural features, and Gods) for consumption at religious ceremonies and other occasions [4]. Despite the known Aztec custom of human sacrifice, the association of human blood with the figures is unclear [3].

After the arrival of the Spanish conquistadors in Mexico in the early 1500 AD, Spanish attempted to suppress Aztec culture and religion; so upon their conquest Amaranthus, as a crop almost disappeared in America (Sauer, 1950). However, according to Spanish missionaries, the use of Amaranthus as food and in traditional cultural practices continued at a reduced level until some 50 years after the Spanish conquest, but subsequently declined [5].

Sauer (1967) reports the introduction of Amaranthus into Spain in sixteenth century, from where it had spread throughout the Europe. Around 1700 AD, it was known as a minor grain plant in central Europe and Russia and by the early nineteenth century it reached Africa and Asia. Till mid-1990s, South Asia was the world's only region where Amaranthus production was increasing [4]. It was in 1970s that research on this plant began in the US, only after new evidence revealed grain amaranth protein to be of high quality [7]. Today, it has spread around the world in different regions of Europe, Asia and Africa [8]. Thus Amaranthus is a historic as well as a contemporary plant.

Morphology

Genus Amaranthus is characterized by the following traits: Annual or (rarely) short-lived perennial life history, herbaceous habit with prostrate to erect stem. Leaves are alternate, ovate to linear and have an indented or notched apex and smooth margins. Flowers are imperfect, in compound dichasia packed into inflorescences. The plants of Amaranthus are monoecious (*A. albus, A. blitum, A. caudatus, A. hybridus, A. powellii, A. retroflexus and A. spinosus) or dioecious (A. tuberculatus, A. palmeri and A. rudis*). The inflorescence is terminal and/or axillary with three to five

tepals and stamens. Monoecious species are generally self-pollinated, wind pollinated. Fruit is utricle or pyxidium. Seeds are lenticular and tiny (0.9 to 1.7 mm diameter and 1000-seed weights from 0.6 to 1 g) that are typically dispersed by wind, water, or birds, having extended period of germination with prolific seed production and a base chromosome number of 16 or 17 [2, 9]. In addition, this genus has C4 photosynthesis, unlike its closest related genera [10]. Morphological terminology in Amaranthus, as used in different floristic and taxonomic treatments, is rather confusing, especially regarding the terms applied to flowers and inflorescence. Within each Amaranthus species there are several races defined by their common branching pattern, height, inflorescence size and form, days to maturity, seed size and colour, and other morphological characteristics [4, 11].

Habitat Preference

Amaranthus has high genetic variability, with diversity in plant form (erect to prostrate), plant height, number of inflorescences (one to several), seed colour, protein content, seed yield, resistance to pests and diseases, and adaptation to soil type, pH, climate, rainfall and day-length [12].

Although Amaranthus can grow on a wide range of soil types and soil moisture levels, it has been reported to grow well in loamy or sandy-loam or silty-loamy soils with good water holding capacity [13] with pH range between 4.5 and 8.0 [3].

Amaranthus is extremely adaptable to adverse growing conditions and tolerates drought and low fertility [14]. Field studies have shown that it grows well on soils varying widely in levels of soil nutrients [3] and responds well to good soil fertility and organic matter [15]. Agricultural fields are a great habitat for annual plants like Amaranthus, which grow naturally in open or disturbed areas and receive full sunlight pointed out that the distribution of Amaranthus species in agricultural fields is associated with high levels of nitrates and low levels of phosphate and potassium.

Phenology

Phenology is the study of periodic biological events that take place at different levels, for example in organs, tissue or cells [16]. The analysis of phenological stages makes it possible to accurately estimate crop-weed competition. Thus phenological surveys are of great importance in weed science and can help us in the development of a realistic and practical model for weed control [17].

Phenology of various Amaranthus species has been reported by several workers. Forcella et al. (1997) reported that emergence of Amaranthus species begins in early April and continues until the end of May. Emergence of A. tuberculatus commences from late May and continues to early August, while as flowering and seed set continue until the first frost. Germination of A. albus and A. blitoides occurs from the middle of May to the beginning of June. The first seeds of A. blitum germinate at the end of June or beginning of July. Flowering of A. albus and A. blitoides begins at the end of June or beginning of July, and of A. blitum at the end of July or early August, continuing until senescence is induced by the first fall frost. Shedding of seeds (A. albus and A. blitoides) and of fruits enclosing the seeds (A. blitum) extends throughout the rest of the growing season, due to the indeterminate growth pattern of inflorescences and the continuous formation of new flowers [18]. A. retroflexus emerges at the end of May and its senescence stage is from November to February; however its phenological stages are slightly dephased for different latitudes, with shorter developmental stages at higher latitudes. A. spinosus emerges in June, flowers in July, fruit develops in August, followed by seed dispersal in September and finally shows senescence in November.

Seed Biology

The detailed understanding of seed biology helps in the development of effective integrated weed management systems [19] has compiled much of the available information on seed biology of

the genus Amaranthus, including research on effects of light, water availability, osmotic potential and salinity, hormones, soil types, burial depth, and other environmental parameters on seed germination.

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