STUDIES ON AMARANTH (*Amaranthus* spp.) CULTIVATION IN OKINAWA, JAPAN

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Amaranth (*Amaranthus* spp.) is popularly consumed as a vegetable in African and Asian countries, because high protein, minerals, L-ascorbic acid and antioxidant properties are available. It is resistant to heat, drought and pest, and grows very fast under a variety of soils and agroclimatic conditions. Sun-radiation and air-temperature are high, and typhoon strikes several times in summer in Okinawa, which limit vegetable production. A series of experiments has been conducted to evaluate growth characteristics, yield and quality of some amaranth lines under seasonal variations, soil types and fertilizers to determine suitable lines, time, soil and fertilizer for amaranth cultivation as a vegetable in Okinawa.

Growth characteristics, yield and quality of seven amaranth lines Bangladesh B (BB), Bangladesh C (BC), Bangladesh Red (BR), India Bengal (IB), Vietnam (V), Taiwan (TW) and Biam Tricolor (BT) were evaluated to select suitable lines. The amaranth lines BB (stem vegetable) and BC (leaf vegetable) grew faster and had higher yield, minerals, crude protein and L-ascorbic acid than other lines.

Growth, yield and quality of amaranth lines BB and BC were evaluated in spring (April-June) and summer (August-September) seasons. Both amaranth lines required about 44 days in spring and 26 days in summer from seed sowing to harvest. Yield and L-ascorbic acid were higher when amaranths were cultivated in summer season.

Soil type (gray soil, pH 8.4; dark-red soil, pH 6.6; red soil; pH 5.4) and fertilizer (Cont (0 g m^{-2}), LN (nitrogen 50 g m^{-2}), HN (nitrogen, 100 g m^{-2}) and NPK (150 g m^{-2}; N:P:K=33.3:33.3:33.3)) regimes were evaluated on growth parameters, yield and quality of amaranth lines IB, TW, BB and BC. The amaranths grew faster, and had highest yield and minerals in gray soil than in other soils. The fertilizers LN and HN promoted yield in gray soil but not in other soils, and yield was highest with the fertilizer NPK in all soils.

Fertilizer regimes (Cont, N, P, K, NP, NK, PK and NPK; NPK at 0, 10, 20, 30, 40, 50, 60 and 80 g m^{-2} (N:P:K=33.3:33.3:33.3)) were evaluated on growth characteristics, yield and quality of amaranth lines BB and BC in gray soil, dark-red soil and red soil. The plants without N and P fertilizers did not grow well or died. Combined fertilizer NPK was the best for growth and yield of amaranths in all soils. Yield, some minerals and L-ascorbic acid were higher with the fertilizer NPK at 50-60 g m^{-2} in gray soil and 30-40 g m^{-2} in dark-red oil and red soil.

Overall results indicate that amaranth lines BB and BC are the best for yield, minerals, crude protein and L-ascorbic acid, which grow best in gray soil and summer season. Amaranth plants cannot grow well without N and P fertilizers. On the other hand, amaranth provides higher yield with N fertilizer in gray soil but not in other soils. Amaranth lines BB and BC provide higher yield and nutritional values with the combined fertilizer of NPK at 50-60 g m^{-2} in gray soil, and 30-40 g m^{-2} in dark-red soil and red soil in Okinawa.