Artemisia annua ANAMED, a Medicinal Plant for Malaria Treatment: A Study on Growth Performance and Artemisinin Content under Tropical Highland Conditions of SW Ethiopia

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Introduction

Worldwide approximately 300 million people are affected by malaria. The problems of controlling malaria are aggravated by inadequate health structures and poor socioeconomic conditions. Over the last few years an increasing resistance to the drugs normally used to combat the parasite causing malaria was observed. As an alternative, Artemisia annua contains artemisinin in leaves and flowers, a sesquiterpene lactone effective against drug resistant malaria. The WHO recommends an artemisinin based combination therapy (ACT). A tea based therapy is also available suitable for low income population as it is cheap. A new strain - Artemisia annua ANAMED (A-3) – adapted to tropical conditions was introduced to south-western Ethiopia in 2001, an area highly affected by malaria.

Objectives

This study aimed at assessing the growth performance of A-3 in SW Ethiopia and changes of its artemisinin content as affected by environmental conditions and growth stage.

Materials and Methods

Field trials were carried out at three locations in the Gamo Gofa Highlands of SW Ethiopia - Boreda, Chencha and Bonke. The research stay of Belay Bekele in Ethiopia was supported by the Eiselen Foundation, Ulm, Germany.

Trial description, data collection & analysis

• 3 fields with 100 m² each
• Artemisia annua ANAMED (A-3)
• Spacing: 1 m x 1 m
• Soil samples were taken before planting and analyzed by using standard methods
• Daily rainfall, minimum, maximum temperature
• At monthly intervals, six to ten plants were harvested to assess dry matter production of A-3 over time
• Before drying, samples were separated into leaves, twigs and branches and air-dried and carefully stored
• Leaf samples of time harvests and final harvest were analyzed for their artemisinin content
• Leaf artemisinin content was determined at Midplant, Courthey by using liquid chromatography with high pressure (CLHP) method

Results

Leaf dry matter increase of A-3 during an 8 months monitoring period as affected by site. Planting dates followed by different letters differ significantly at P≤0.05.

Conclusions

• An altitude of 2,200 m a.s.l. with a minimum and maximum temperature of 17.3 and 24.5°C led to a better growth performance of A-3 than higher elevations (2,600-2,900 m a.s.l.) and lower temperatures (8.4;18.3 and 10.4;16.3°C).
• A lower but well distributed rainfall (480 vs. 850-1,050 mm) was found at the lower elevation which was also favourable for artemisia growth.
• These conclusions are supported by negative correlations between leaf yield of A-3 and altitude (R²= 0.86), rainfall amount (R²=0.85) and positive correlations for temperature (T w\text{min}; R²=0.99, T w\text{max}; R²=0.91) and leaf yield.
• Similar relations were for leaf artemisinin content with altitude (R²=0.96) and rainfall (R²=0.92)
• Relationships between A-3 yield and artemisinin content were less clear and require further assessment.

Open research questions

• What is the effect of lower altitudes, e.g. 1,500 to 2,200 m a.s.l., on A-3 growth and artemisinin synthesis?
• What is the impact of fertilisation on yield and artemisinin content?
• Can we grow A-3 at higher densities and harvest earlier without loss of current yield level? The maximum of artemisinin content was already achieved 4 months after planting so that two crops can be grown per year.
• Can we intercrop A-3 and food crops?

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