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Dualistic roles and management of non-cultivated plants in lowland rice systems of East Africa

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ABSTRACT

An ethnobotanical study in lowland rice areas in East Africa was undertaken to assess farmers' knowledge on the usage of non-cultivated plants occurring in paddy fields, and to understand what rice farmers in this region do with useful species once they encounter them in their crop. Inventories of weed species in 19 rice schemes in Tanzania and Kenya were followed by interviews among 380 experienced rice farmers, community elders and traditional healers, grouped into 19 informant groups. Among informant groups, a high degree of consensus about uses of weeds growing in rice paddies was observed. From a total of 222 observed rice weed species, the informant groups identified 67 species with usages described in 1300 use reports. Among these 67 species, 20 are among the most commonly cited weed species in rice paddies in sub-Saharan Africa. Only in 42 cases (3% of the total use reports) did the farmers indicate that they collected (13 species) or spared (four species) these weeds during weeding. In all other cases, such plants were removed or killed during weeding, irrespective of their usefulness. Non-cultivated plants that are spared are those of which the putative agronomic qualities (i.e. for crop protection or soil improvement) are considered more important than their crop competition effects (i.e. *Azolla filiculoides* and *Marsilea crenata*) and those that are found in the field margins, which do not compete with the crop. Non-cultivated plants that are collected during weeding have food, fodder or medicinal purposes or a combination of purposes. The most cited species that are collected or spared during weeding were *Bidens pilosa*, *Ipomoea aquatica*, *Corchorus olitorius* and *Stachytarpheta jamaicensis*. This study revealed that lowland rice farmers in East Africa generally have a high level of understanding and consensus on the usefulness of the non-cultivated plants growing in lowland rice schemes. When they occur in their crop however, the vast majority of these species are primarily seen as weeds and consequently removed or killed.

1. Introduction

Among the numerous production challenges African rice farmers are facing, competition from weeds is considered as one of the most common and serious (Waddington et al., 2010). Weeds are defined as non-cultivated plants that are not desired in crop fields since they compete with crop for nutrients, soil moisture, sunlight and space. Or more philosophically, as plants whose virtues have not yet been discovered (Zimdahl, 2007). Rice (*Oryza sativa* L.) is the fastest growing cereal commodity in sub-Saharan Africa (SSA), with an estimated annual paddy production increase of 9.5% (Seck et al., 2012). Rice is a volatile crop that can be grown under a range of hydrological conditions ranging from free-draining rain-fed uplands to continuous flooded lowlands (Andriesse and Fresco, 1991). Much of the rice is however grown in the temporary or continuous flooded lowlands (either rain-fed or irrigated) of Africa, covering an estimated 64% of the total area under rice and producing about 73% of the total annual paddy production of the region (Diagne et al., 2013). Rice production systems are predominantly small-scale and subsistence oriented in this region. Yield losses due to uncontrolled weeds are estimated to range between 28% and 74% in transplanted lowland fields, and 28% and 89% in direct-seeded lowland rice (Imeokparia, 1994; Diallo and Johnson, 1997; Johnson et al., 2004). Even despite weed control, rice production in lowlands is estimated to lose 15% (irrigated lowlands) to 23% (rain-fed lowlands) due to competition from weeds under current weed management practices (Becker and Johnson, 2001; Becker et al., 2003). Conservative estimates therefore show that weeds account for annual rice yield losses of 2.2 million tons equating to US$1.45 billion in SSA (Rodenburg and Johnson, 2009).

Non-cultivated plants in agricultural fields are however not just harmful; some species have use values too. They may have various purposes as medicines, food and fodder, construction, fuel and even as pest regulators, green manure or cover crops (Hillocks, 1998). Rural people

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Fig. 1. Map of East Africa, indicating the geographic locations of the study sites (numbers 1–19): 1. Garsen (FI), 2. Kimbuni (PI), 3. Mangwena (PI), 4. Kinyakuzi (RF), 5. Tibirinzi (PI), 6. Mwera (PI), 7. Mtwango (PI), 8. Kiyanga (PI), 9. Luganga (FI), 10. Magozi (FI), 11. Wami (FI), 12. Ruandamajenje (FI), 13. Mkula (FI), 14. Lumemo (FI), 15. Kilasilo (RF), 16. Mtopesi (FI), 17. Namatuhi (FI), 18. Mtonya (FI), 19. Makomboni A (RF). FI = fully irrigated lowland, PI = partially controlled lowland, RF = rain-fed lowland.

indeed extensively use non-cultivated plants, including weeds, for their daily needs (Dansi et al., 2008; Rodenburg et al., 2012). Therefore, weeds may play a role in farmers' livelihoods as well as in cropping systems diversification. Useful weed species can be (1) spared during hand weeding operations, (2) nurtured and conserved where they spontaneously emerge or even (3) purposely planted and nurtured (Rodenburg et al., 2012). However, little is known about the useful weed species growing in rice production ecosystems in SSA—East Africa in particular—and the use purposes of these species and the ways subsistence rice farmers deal with the apparent dualism between their usefulness and their weediness. The specific objectives of the study were therefore (1) to assess farmers' ethnobotanic knowledge on rice weeds in East Africa and (2) to understand what rice farmers in this sub-region do with useful species once they encounter them in their crop. We chose rice production systems in East Africa as this area is yet unexplored in this regard.

2. Materials and methods

2.1. Field survey and data collection

An ethnobotanical survey was conducted during the cropping season, from 20 March to 19 July 2012, in 19 rice schemes in Tanzania—in the areas Pemba (4 schemes), Zanzibar (3), Iringa (2), Dakawa (1), Mbarali (1), Kilombero (2), Kyela (1) and Songea (4)—and in Kenya, in the region Garsen (1 scheme) (See Fig. 1). The selected rice schemes are characterized as rain-fed and irrigated lowland rice-growing environments, with a tropical savanna climate characterized by a monomodal rainfall regime (annual rainfall ranging from 800 to 2200 mm).

A total of 380 informants (96 men and 284 women), 20 from each scheme, were interviewed. Informants were selected prior to the survey with the help of National Agricultural Research Systems (NARS)—Agricultural Research Institute Uyole (ARI-Uyole), Agricultural

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