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Macrofungal Diversity in Gashaka Gumti National Park

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ABSTRACT

National parks, like Gashaka Gumti-National Park were established to protect, preserve, conserve and manage representative samples of indigenous flora and fauna. Diversity studies of macrofungi have grown during the recent years, because they are important components of biodiversity serving as key primary colonizers in ecosystem, deadwood decomposition and with variety of uses as food, pharmaceutical and medicinal qualities. This study reports on the wet season diversity and distribution of macrofungi in Gallery Forest and Savanna woodland vegetation of Gashaka Gumti-National Park in Northern Nigeria based on fruit body characteristics. A total of 37 species of macro fungi distributed across 21 families were encountered. The Gallery Forest recorded the highest number of species (21 species) compared to Savanna woodland (17 species) during the sampling period. The distribution of species across families showed that Mycenaceae had the highest number of species, followed by Agaricaceae, Bolbitiaceae, Xylariaceae and Tricholomataceae while twelve of the other families had only one species each. This revealed that macrofungi utilized wide range of substrates where the soil had 21 (53.85 %) species, followed by log with 18 (48.72 %), leaf litter 5 (10.26 %) and one (5.13 %) species from fruit shell. The availability and the types of substrates are important drivers of macrofungal composition with majority (78.38 %) of macrofungal species occurring on a single type of substrate (substrate-specific). The list of macrofungi in this study provides the baseline information on the assessment of changes in macrofungal diversity in the National Park.

Keywords: Composition, Gashaka Gumti National Park, Macrofungi, Substrates.

INTRODUCTION

Macro Fungi, a collection of heterotrophic organisms is one of the most diverse groups of organisms on earth, and are important components of biodiversity and are key-players in ecosystem processes viz deadwood decomposition (Seen-Irlet *et al*., 2007). Macrofungi play an extensive role as primary colonizers in the ecosystem via decomposition of wide range of organic matters resulting in nutrient and carbon cycle in the forest (Ajiya, *et al*., 2018). Furthermore, they are significant as nourishment source for human beings and animals. Many kinds of macro fungi are not edible but possess variety of pharmaceutical and medicinal qualities. The macro fungi are also used as a bioindicator of environmental quality. Despite their biological, ecological and economic importance of macrofungi and the recent growing interest in macrofungi studies, only about 6.7% of 1.5 million fungi are recorded and describe worldwide with high diversity in the temperate region.

There is paucity data on diversity and composition of macrofungi in many parts of Africa. Very little is known about macrofungi diversity, ecology and distribution in the northern part of Nigeria. Although, some researches and publications exist on the

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diversity and distribution of mushrooms in Nigeria (Osemwegie *et al*., 2006; Alabi, 1991; Adewusi *et al*., 1993), little or no work has been done from the northern part of the country. No studies on macro fungal flora have been carried out in the Gashaka-Gumti Park even though the macrofungi of Ngel Nyaki forest reserve and Mount Cameroon have been documented (Ajiya *et al*., 2018). There is a rubout ecological relationship between macrofungi and its substrate. Traill *et al.,* (2013) recognize the relevance of rainfall to species availability, composition and spread, and as the most important denominator that separates West Africa from Central, East and South African sub-regions.

Osemwegie *et al.,* (2014) reported that the West Africa was irrefutably as one of the major hotspots of fungi with climate condition of the region accounted for the high population density. Gashaka Gumti Park, the largest (6,731sq km) of the seven National Parks in Nigeria, is situated in the sub-Sahara Guinea Savannah zone in the North-eastern highlands of Nigeria. The National Park (GGNP) which shares boundary with Faro National Park in the Republic of Cameroon. The park has four (4) major rivers that support the establishment of flat grass land, gallery forests, low land rainforest, wetlands, and montane forests and montane grass habitats in a continuous ecological transition unique to the West African sub-region. Each habitat type supports its own distinctive and wide variety of aquatic and terrestrial animals and plants like the macro fungi.

The pristine state of the area and the great number of decaying trunks at different stages of wood decomposition offered a unique opportunity to optimize the diversity of macro fungal community. This study, deemed it necessary to obtain preliminary report on the composition of macro fungi that will serve as baseline information for further extensive research. This study will also serve as a reference point for monitoring changes in the macrofungal community and for the conservation of biodiversity in the ecosystem. Thus, the aim of the study is to determine the composition and distribution of macro fungi found in the two vegetation types of Gashaka - Gumti National Park.

MATERIALS AND METHODS

Study Area

largest National Park in Nigeria, located in Taraba State from the north eastern part of the country. The National Park (GGNP) also shares international boundary with the Republic of Cameroon, adjacent to Faro National Park in that Country. The park lies between latitudes 6º 55' and 8º 05' north, and longitude 11º11' and 12º13' with an estimated landmass of 6,731 square kilometers of mountainous terrain deep rolling valleys and flat land. The highest mountain in Nigeria–Gangirwal (2400 m) is located within the park. Gashaka-Gumti National Park has natural transition between habitat types which include the followings: flat grass land, guinea savannah-word lands, gallery forests, low land rains forests, montane forests and montane grass land. Each habitat type supports its own distinctive community of plants (over 1,000 different species recorded) and animals (about 102 species of mammal so far recorded). It is expected that National Park will provide sanctuary a wide variety of aquatic and terrestrial plant, especially the macro fungi.

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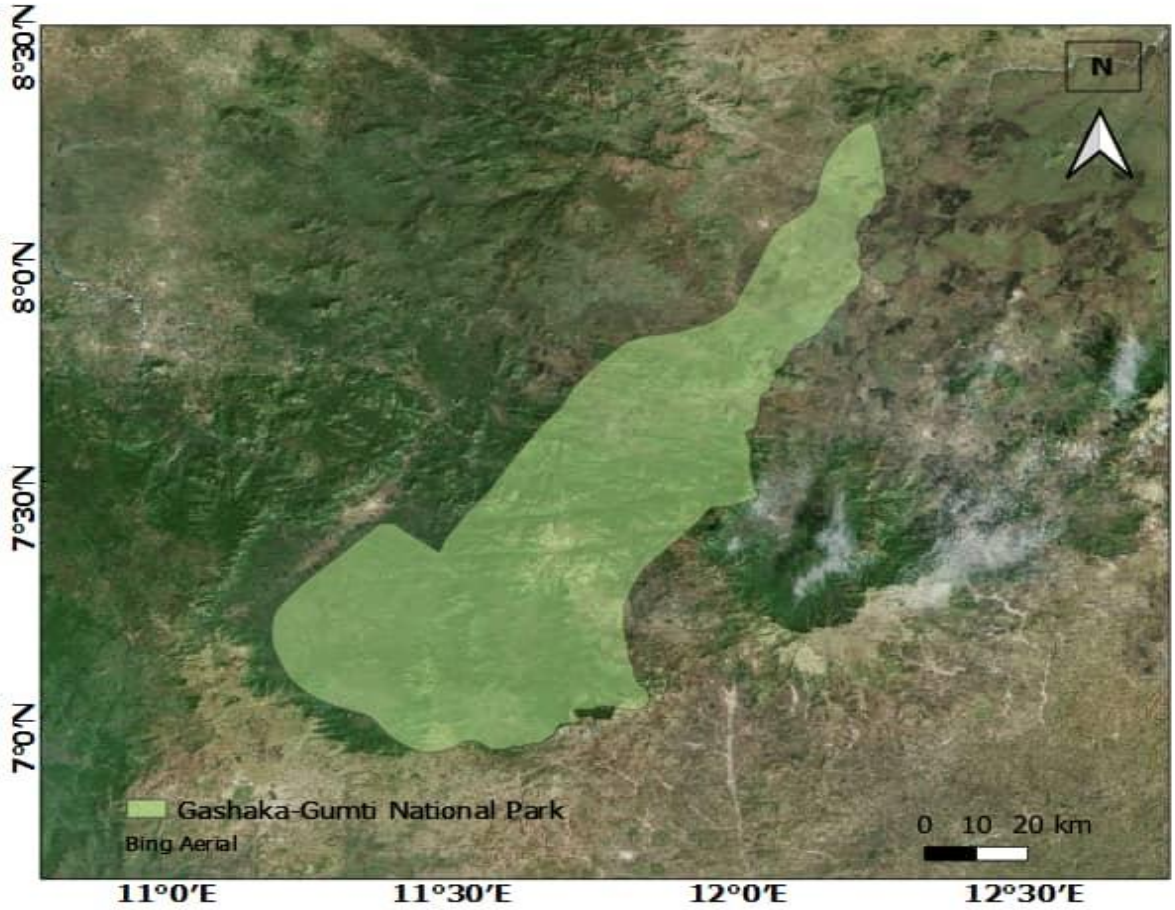

Figure 1: Map of Gashaka-Gumti National Park

Study Site

The study sites comprise of two vegetation types: Savanna woodland and Gallery Forest characterized by abundant fallen and decaying trunks and natural stumps, which have not been touched by forestry. The plots ware established in a homogeneous area as possible and each plot consists of 3 transects of 100m long which was laid out parallel to one another at 10m intervals. Each transects consists of a total of 5 segments 10 x 10 m subplots per transect. The fruiting bodies of the macro fungi in a subplot were photographed, collected, labeled accordingly noting it substrate and placed in an appropriate bag or container for transportation. (Douanla – Meli, 2007).

Sample Collection

The survey was conducted at the peak of the rainy season to coincide with favorable conditions that support the optimal growth and development of macrofungal fruiting bodies. Macro fungal sporocarps (reproductive structure) visible to the naked eye on different substrates were identified in situ where possible, using illustrations in colour field guides and keys (Scott, 2006; and Lodge *et al*., 2004). The fruiting bodies of the macro fungi in a subplot were enumerated noting the substrate in each case and representative sample photographed, collected, placed in an appropriate bag or container for transportation (Douanla – Meli, 2007). Collected specimens were preserved in the

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herbarium of the Department of Biological Sciences, Taraba State University Jalingo.

RESULTS

Macrofungi Composition of Gashaka Gumti National Park

A total of thirty-seven (37) macrofungal species were encountered in both Gallery Forest and Savanna woodland of Gashaka Gumti National Park which were distributed across twenty-one (21) families. The results revealed that Galary Forest hold diverse composition of macrofungi fruiting bodies unlike Savanna woodland. Major samples collected were Agarics with the total number of twenty-three (23) species followed by seven species of Polypores while Coral and Jelly fungi were represented with one species each as shown in table 1.

Table 1: List of Macrofungi Species and Fruiting body Forms encountered in Gashaka-Gumpti National Park, Nigeria

Macrofungal Taxa	Families	Fruiting Forms	Substrate				Vegetation	
			Soil	Log	Liter	Fruit Shell	Gallery Forest	Savanna Woodlan
Agaracus Xanthodermus	Agaricaceae	Agarics	+	-	-	-	-	+
Agaricus sp	Agaricaceae	Agarics	+	-	-	-	-	+
Amanita sp	Amanitaceae	Agarics	+	-	+	-	-	+
Auricularia auricula-judae	Auriculariaceae	Jelly fungi	+	-	-	-	-	+
Clavaria sp	Geoglossaceae	Corals	+	-	-	-	+	-
Clavulinopsis sp	Clavariaceae	Xyaria	+	-	-	-	+	-
Entoloma abortivum (Berk. & Curtis) Donk	Entolomataceae	Agarics	-	+	-	-	+	-
Galerina farinacae	Strophariacea	Agarics	-	+	-	-	-	+
Ganoderma sp1	Ganodermataceae	Polypores	-	+	-	-	-	+
Ganoderma sp 2	Ganodermataceae	Polypores	-	+	-	-	-	+
Geoglossum cookeanum Nannf.	Xylariaceae	Xylaria	+	-	+	-	+	-
Hebeloma sp	Hymenogastraceae	Agarics	+	-	-	-	+	-
Helvella sp	Helvellaceae	Agarics	-	+	-	-	+	-
Hemimycena mairei (Gilbert) Singer	Mycenaceae	Agarics	-	+	-	-	-	+
Heterobasidion perplexa	Bondarzewiaceae	Polypores	-	+	-	-	-	+
Heterobasidion sp	Bondarzewiaceae	Polypores	-	+	-	-	-	+
Hygrocybe mucronella (Fr.) P. Karst.	Geoglossaceae	Agarics	+	-	-	-	+	-
Lepista sp 1	Tricholomataceae	Polypores	-	+	-	-	+	-
Lepista sp2	Tricolomataceae	Polypores	-	+	-	-	+	-
Macrolepiota dolichaula	Lepiotaceae	Agarics	+	+	-	-	-	+
Macrotyphula sp	Xylariaceae	Agarics	-	-	+	-	+	-
Marasmius crinis-equi F.Muell. ex Kalchbr.	Marasmiaceae	Agarics	+	-	+	-	+	-
Marasmius sp	Marasmiaceae	Agarics	+	+	-	-	+	-
Melanolenca sp	Tricholomataceae	Boletes	+	-	-	-	-	+
Mycena alba	Mycenaceae	Agarics	-	+	-	-	+	-
Mycena aurantiomarginata	Mycenaceae	Agarics	+	-	-	-	+	-
Mycena stylobates	Mycenaceae	Agarics	+	-	-	-	+	-
Panaeolus sp	Bolbitiaceae	Agarics	+	-	-	-	-	+
Phlebopus monticola	Sclerodermatinea	Boletes	+	-	-	-	-	+

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Pleurotus ostreatus	Pleurotaceae	Agarics	-	+	-	-	+	-
Pleurotus sp	Bolbitiaceae	Agarics	-	+	-	-	+	-
Schizophyllum commune	Schizophyllaceae	Agarics	+	+	-	-	-	+
Tremetes sp	Polyporaceae	Polypose	+	+	-	-	+	-
Xylaria longipes	Xylariaceae	Xylaria	+	-	+	-	+	-
Unidentified 1		Agarics	-	+	-	-	-	+
Unidentified 2		Agarics	+	-	-	-	-	+
Unidentified 3		Agarics	-	-	-	+	+	-

Distribution of Macrofungal Species Across Families

The results shows that the family Mycenaceae was represented with the highest number of species, followed by Agaricaceae, Bolbitiaceae, Xylariaceae and Tricholomataceae while twelve of the other families were represented by only one species as shown in figure 1.

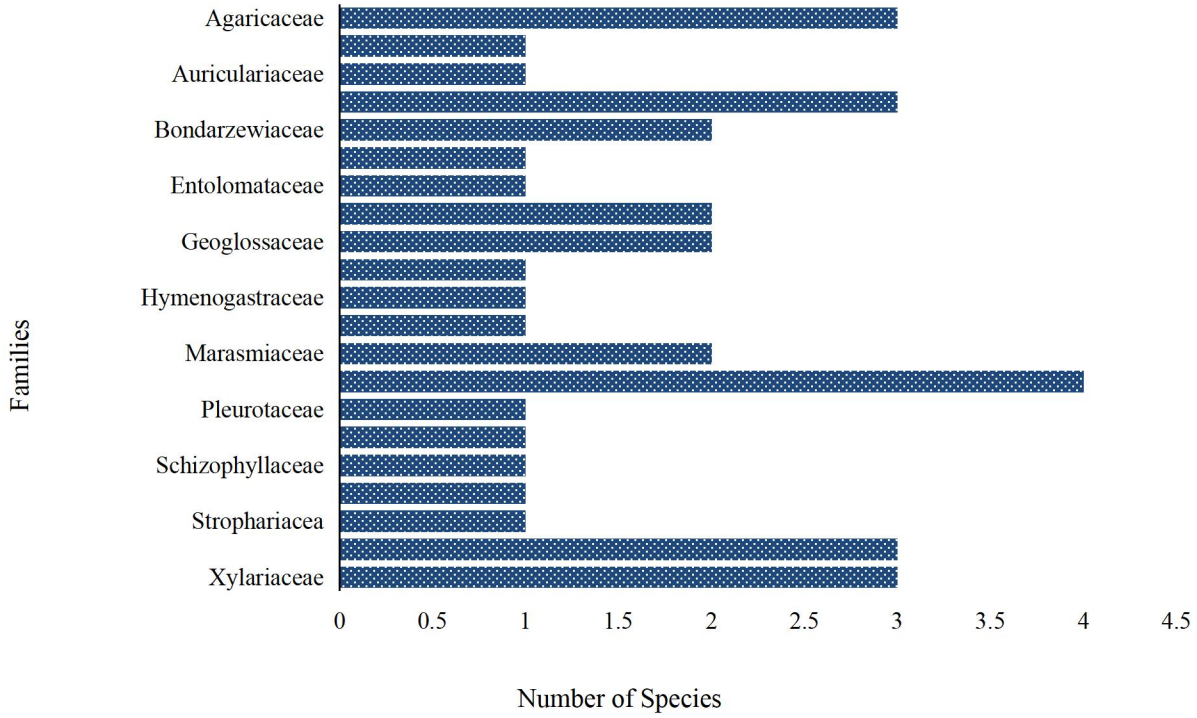

Figure 1: Distribution of Species across families of macrofungi recorded Gashaka-Gumti National Park

Distribution of Macrofungi Across Vegetation Types

Figure 2 Shows The Distribution Of Macrofungal Species Across Vegetation Types, Out Of Thirty-Seven (37) Macrofungi Species Sampled, It Was Revealed That Twenty (20) Species Were Occurred In Gallery Forest Compared To Seventeen (17) Species From The Savanna Woodland And None Of The Species Showed Common Occurrence In The Survey.

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Figure 2: Number of Species Recorded for the different vegetation Types

Diversity Indices and Species Evenness of Macrofungi in Gashaka Gumti National Park

Table 2 presented the diversity indices and species evenness of macrofungi in the Gallery Forest and savanna vegetation. It was revealed that Gallery Forest had the highest diversity indices compared Savanna woodland (3.05 and 2.94 respectively) while species evenness was almost the same (0.9028 and 0.9068) for both vegetation types.

Table 2: Diversity indices of macrofungi communities in relation to vegetation types

	Gallery Forest	Savanna Woodland
Taxa S	20	17
Dominance D	0.0476	0.0526
Simpson_1-D	0.9524	0.9474
Shannon H	3.0450	2.9440
Evenness_e^H/S	0.9028	0.9068

Substrate Utilization of Gashaka-Gumti Macrofungal Species

Figure 3 shows four types of substrata (Log, Soil, leaf Litter and Fruit Shell) that influenced the composition of macrofungi in this survey. All the Polypores (*Ganoderma* spp, *Heterobasidionperplexa*, *Heterobasidion* sp, *Lepista* spp except *Tremetes* sp) occurred only on the logs. The soil was found as major habitat with 21 (53.85 %) species, followed by log with 18 (48.72 %), leaf litter 5 (10.26 %) and one (5.13 %) species from fruit shell (Figure 3). The majority (78.38%) of macrofungal species in this study lived on a single type of substrate (substrate-specific) and were limited in their composition by substrate availability. Only a few (21.62%) macrofungi (seven species, 8 genera) were observed to occupy more than one substrate.

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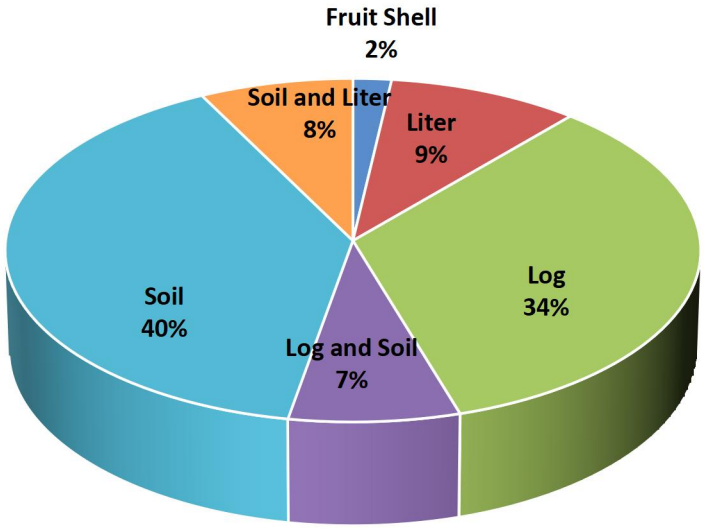

Figure 3: Distribution of macrofungal species across substrates

DISCUSSION

This is the first report that describe the qualitative analysis of macrofungi diversity of two vegetation types: Gallery Forest and Savanna woodland of Gashaka Gumti National Park which revealed clear differences in their species composition and abundance. The distinct fruiting groups of macrofungi in the two vegetation are an indication that the diversity and distribution of macrofungi which are correlated with the plant community type and the unique environmental conditions prevailing in different vegetation types. In the composition and distribution of macrofungal species, Gallery Forest tend to be more diverse unlike Savanna woodland due to prevailing environmental factors such as high precipitation, temperature, humidity, soil nutrient availability and plant species have been put forward as the primary factors responsible for differences in macrofungal species richness and community composition (Hillebrand 2004, Lentendu *et al.,* 2011; Bahram *et al*.,2012; Singh *et al.,* 2012; Tedersoo *et al.,* 2014). The many species that occurred only in the Gallery Forest or the savanna might be due to clear difference in soil moisture and relative humidity, sunshine and type and, availability substrate types. The same reason accounted for the higher diversity for Gallery Forest compared to the savanna.

Lodge *et al*. (2004) reported that the type of vegetation in an area affects the species richness and composition of macrofungi at that site. They also discovered that Grasslands, deserts, forests, tundra, and other habitats all have characteristic species. The fact that the two vegetations supported distinct groups of macrofungi is also an indication that these two vegetations could jointly provide a complementary range of macrofungal habitats in the study area. The diversity of macrofungi greatly varied across the two vegetation types depicted by Shannon Index (3.0450 and 2.9440 respectively) as Gallery Forest was more diverse compared to Savanna woodland as a result of higher anthropogenic activities this conformity with the findings of Tabuhwa

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(2011) who reported similar pattern across three habitats showing that land used substantially affected the distribution of macrofungi diversity. Majority of the fungi belonged to the Agaricales, followed by the Polyporales which agrees with the findings of similar works by Kinge *et al.,* (2013) in neighboring Cameroon and the finding of Tabuhwa (2011) from his study on diversity of macrofungi at the University of Dar es Allam Mlimani Tanzania reported the abundance of Agaricus and Polypores which is attributed to the fact that these species are saprotrophic capable of utilizing organic component of their substrate.

The relatively higher abundance of species of *Mycena* and *Marasmius and species of Xylaria,* found on wood and leaf litter as saprotrophs agrees with Alexopoulos *et al., (*1996). The research reveals that bulk of macrofungi (78.38%) showed substrate specificity. This collaborates with the findings of Tibuhwa (2011), who studied substrate specificity and phenology of macrofungi community in Tanzania. The soil recorded high number of species followed by log agreed with the findings of Nwordu *et al*., (2013) report on identification of some wild edible macrofungi who reported that 40 % of the macrofungi were sampled from soil and dead wood which provides a conducive that support the growth of macrofungi due to high moisture content and degraded nutrients. This is because this report was based on sampling in the wet season only where most of the tiny, less tolerant species were found on the damp, more shaded and moist humus rich soil at that time. These observations have broadened our understanding of how substrate type and availability could explain macrofungal distributions.

CONCLUSION

The study of macrofungi Composition of two vegetation types in Gashaka Gumti-National Park showed the occurrence of species that are representative of the vegetation type. Based on the findings of this preliminary survey, it reveals that Gashaka Gumti National Park will hold a significant diversity and abundance of macrofungi when an in-depth study cutting across both rainy and dry reason is conducted. Notwithstanding, it is an important first step towards producing a checklist of macrofungi in Gashaka Gumti National Park. The list of macrofungi in this study provides the baseline information needed for the evaluation of changes in macrofungal diversity in Gashaka Gumti Region. Our findings suggest that different microhabitat favours the occurrence of different macrofungal species, and sporocarps and thus all the vegetation types should jointly be sample to provide a complementary range of macrofungal habitats for the study of the park. In conclusion, the availability and the types of substrates are important drivers of macrofungal composition, and accordingly macrofungal species occurrence is potentially dependent on the habitat factors such as moisture, humidity, sunshine and availability of different substrates.

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