Composition of Weeds in Cocoa Plantation at North Aceh Regency Province of Aceh Indonesia

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Abstract. The cocoa crop is an important source of income for many farmers in the North Aceh region, and other neighboring regions at Aceh Province. Cocoa production has great economic importance in this region and in much of the state of Indonesia. Diversity of weeds in cacao plantations of North Aceh region, and other neighboring regions at Aceh Province was conducted in August to November 2020. This survey followed a few steps: collecting, counting, drying and species identification. The phytosociological parameters, namely frequency, density, abundance, relative frequency, relative density, relative abundance and the Importance Value Index (I.V.I.), were used for analysis. A total of 10 botanical families were identified, distributed in 18 species. These are families Euphorbiaceae, Oxalidaceae, Onagraceae, Urticaceae, Lamiaceae, Cyperaceae Commenlinaceae, and Capparidaceae. The species, which showed the highest levels of Summed Dominance Ratio (SDR) value were: *Peperomia pellucida* (49.31), *Laportea interrupta* (14.81), *Cleome rutidosperma* (13.89), and *Synedrella nodifloram* (7.39).

Key words: cacao, weeds composition, weeds distribution, weeds structure

Introduction

Weeds are a limitation to cocoa production in the world (Konlan *et al*., 2019). The interference of weed plants leads to reductions in yields (Pipitone, 2016). It is estimated that losses caused to agricultural crops by weed interference in Brazil are around 20-30% (*Lahive et al*., 2019). Agricultural crops and weeds have demands for environmental resources, such as light, gas, and nutrients and water, which often become scarce. In this way, it is established that competition and agricultural crops are subject to a number of environmental factors that influence growth, development and economic productivity.

The period of greatest competition of weeds with the cocoa occurs during the months of low rainfall precipitance, and weed control aims to reduce competition by factors of the environment exerted by the invaders on the cocoa tree crop, as well as facilitating other cropping practices, especially fertilization and harvesting (Aneani *et al*, 2012). Plantation is an integral part of the agricultural sector in Indonesia that has an important role compared to others, one of them is cocoa.

Cocoa plantation is one of the main commodities in Indonesia that affect to the economics especially in providing employment, farmers income and foreign exchange for the country (Lukito, 2010). North Aceh region is one of the areas that most of the population uses the plantation for their daily necessities, with 1.450 hectares of cocoa plantations. One of the current problems was the decreasing of the yields due to the weed attacks. The analysis or phytosociological study is an important tool to know, monitor and understand which weed species are present in the assessed area and in what form they are distributed, and according to Huqi *et al.* (2010), through these analyzes can be formulated strategies and management techniques, aiming to adopt integrated control practices, where the main objective is not to eliminate all weeds, but to keep them within an economical and manageable limit.

Moreira *et al.* (2013) emphasize that the study of plant communities or phytosociological studies compare weed populations at a given moment, considering the consequences of the management application. Based on these descriptions, this study was

aimed to obtained the species of weeds in North Aceh region and provided information about the diversity of weed in Province of Aceh.

Materials and Methods

This research was carried out in North Aceh, Province of Aceh, on the cacao plantations, which was conducted in August 2019. The sampling was done by exploration method in both plantation areas. Weeds collection that found in the field were labeled with the collection number. The phytosociological survey was carried out in 0.5 ha of a 3-year-old cocoa crop grown under 3 x 3 m spacing.

The weeds were collected through the square inventory method, which consists of the use of a square of wood, with an area of 1 m^2, randomly launched zigzag walking through the site (Tracewicz *et al.*, 2012). The frame was thrown 5 times, totaling an area of 5 m^2. The weed samples were collected at the demarcated sites, separated by species, stored in plastic bags and sent to the Weeds Laboratory of the Agriculture Faculty of Universitas Malikussaleh, where they were identified, counted and dried in an oven at a temperature of 60º to 70º C until reaching constant weight. To identify the species, we used as the reference book for identification by Weeds of Rice in Indonesia (Soerjani *et al.*, 1987).

Results and Discussion

Analysis of weed vegetation on cacao plantations in North Aceh is shown in Table 1. Table 1 showed weeds in the cacao plantations there are 3934 individuals, 56 species, 47 genera and 20 families. A group of weeds with 7 types, a grass group with 10 species, a broad-leaved group with 18 families with 38 species and a fern group with 1 family and 1 species. The number of individuals *Paspalum conjugatum* at most (1029 individuals) and *Cuphea platycentra* at least (2 individuals).

In this cacao plantation, the dominant family is the poaceae/graminae family which consists of 10 species with 1684 individuals. The family Poaceae, the two families that had a large number of individuals were the Asteraceae family with 602 individuals and the family of Acanthaceae with 702 individuals. While the families are Lytheraceae, which is 1 species with 2 individuals. *Paspalum conjugatum* is a weed found in plantation and food crops. This weed is often found in plantations on garden land and is classified as an important weed on several food crop fields. *Paspalum conjugatum* reproduces by seeds and stolons (Konlan *et al.*, 2019).

The number of seeds produced by each individual means that the opportunity for growth is also greater so that this plant can be found everywhere in the open or somewhat protected (Holm *et al.*, 1997). An individual *Paspalum conjugatum* can produce 1500 seeds and the seeds are easy to spread, causing opportunities to grow and reproduce even greater. *Paspalum conjugatum*, which is the dominant plant in cacao plantations, is *Asystasia coromendaliana* from the Asteraceae family (as many as 702 individuals). *Asystasia coromendaliana* is a broadleaf weed found on plantation and food crop fields. This weed is often found in crops on dry land and is classified as an important weed on several plantation lands.

Table 1. Weeds flora in cacao plantation of North Aceh district

Species	Family	Number of species
Asystasia coromandeliana Nees.	Acanthaceae	702
Ageratum conyzoides L.		224
Clibadium surinamense L.		14
Crassocephalum crepidioides (Benth) S. Moore		6
Emilia sonchifolia (L.) DC. ex Wight		16

Gynura bicolor DC.	Asteraceae	23
Mikania micrantha Kunth		47
Porophyllum ruderale (Jacq.) Cass.		8
Sonchus arvensis L.		16
Spilanthes acmella Auct. non (L.) Murr.		15
Sparganophorus vaillantii Crantz		9
Synedrella nodiflora (L). Gaertn.		28
Vernonia cinerea (L.) Less.	Capparidaceae	10
Eupatorium odoratum L.f.	Campanulaceae	186
Cleome rutidosperma DC.	Caryophylaceae	22
Isotoma longiflora (L.) Presl.	Commelinaceae	8
Drymaria cordata (L.) Willd.		9
Commelina diffusa Burm. f.		7
Cyperus brevifolius (Rottb.) Hassk.		8
Cyperus compressus L.	Cyperaceae	16
Cyperus halpan L.		14
Cyperus kyllingia Endl.		8
Fimbristylis miliaceae (L.) Vahl		11
Fimbristylis tomentosa Vahl		7
Scleria sumatrensis Retz.		8
Acalypha hispida Burm. f.	Euphorbiaceae	17
Croton hirtus (L'Herit) M.A.		14
Euphorbia hirta L.		112
Euphorbia prunifolia Jacq.		14
Phyllanthus niruri L.	Lamiaceae	11
Hyptis brevipes Poit.		13
Hyptis capitata Jacq.	Lygodiaceae	7
Lygodium mycrophylum (Cav.) R.B.l	Lytheraceae	6
Cuphea platycentra Auct. non Bth.	Melastomataceae	2
Clidemia hirta (L.) D. Don		287
Melastoma malabathricum Auct. non L.		60
Mimosa pudica L.	Mimosaceae	9
Oxalis barrelieri L.	Oxalidaceae	65
Paspalum conjugatum (Swartz) Beauv.	Poaceae	419

Asystasia coromendaliana is an important weed for food crops found in coconut, cacao and rubber plantations (Sastroutomo, 1990). *Cuphea platycentra* from the lytheracea family is the least weed found in this cacao plantation (as many as 2 individuals). *Cuphea platycentra* is an herbaceous species that grows and is dominant in wetlands (Navie, 2011). This species generally grows abundantly in humid habitats, such as along waterways or drainages, and swamps. This property causes this weed to grow a little on dry land (plantations). Weeds in plantations are a mixture of broadleaf weeds, grasses, puzzles and ferns (Navie, 2011). Furthermore, Lamid (1996) stated that the weeds that were mostly in dry land (gardens) were weeds from the broadleaf group. On dry land (gardens) nutrient uptake by weeds takes place faster, which causes weed growth to be faster and more fertile (Ridwan & Jamin, 1994). Weeds are the same as other plants that require suitable living conditions and an environment for their growth. If the environment is no longer suitable for growth, the weeds that grow will decrease in number or cannot grow at all in that environment.

Table 1, showed that there are important weeds that can cause considerable losses. Imperata cylindrica is considered one of the top 10 worst weeds in the world because it is fast

growing, thrives in fields such as gardens, lawns and roadsides. Produces rhizomes, spreads seeds very quickly and over long distances, roots and rhizomes are very resistant to fire. *Imperata clyndrica* is a perennial plant, growing in loose tufts or dense, scaly rhizomes with thin spikes (Soerjani, 1974). *Mikania micrantha* is a plant that is easy to spread and reproduce quickly. This plant has a fast power to grow in any environment such as humid land and dry land. So that this plant is a big threat to agricultural crops because it threatens to take nutrients.

Mikania micrantha in Australia is a type of plant that is very threatening to agricultural growth because it causes serious damage to agricultural crop production. *Mikania micrantha* is an herbaceous plant whose life spreads to other plants, both in trees, shrubs and shrubs. This plant is very fast growing because in a day it can grow as much as 9 cm. This plant grows very fast during the rainy season.

Weed Structure

Data analysis that has been carried out shows the results of the weed structure in cacao plantations in North Aceh (Table 2). The values of relative density, relative frequency, relative dominance, importance value, and SDR value of 10 dominant weed species are presented, each of which varies between one species with other types. The weeds with the highest SDR value were *Paspalum conjugatum* (19.48%) and the weeds with the lowest SDR *Cuphea platycentra* (0.19%). Table 2 shows that the weed *Paspalum conjugatum* is the most dominant among other species in this cacao plantation.

Table 2. Weeds species dominant in cocoa plantation at North Aceh Regency Province of Aceh Indonesia

No	Weeds species	Frequency	Uniformity	AD	RD
1	*Paspalum conjugatum* Berg.	19.08	10	0.31	0.55
2	*Asystasia coromandeliana* Nees.	5.92	1	0.12	0.21
3	*Clidemia hirta* (L.) D. Don.	6.58	2	0.18	0.32
4	*Axonopus compressus* (Swartz) Beauv.	11.84	5	1.23	2.16
5	*Eupatorium odoratum* L.f.	13.82	6	0.15	0.26
6	*Ageratum conyzoides* L.	11.84	5	1.54	2.71
7	*Imperata cylindrica* (L.) Beauv	2.63	1	0.12	0.21
8	*Borreria alata* (Aubl.) DC.	15.13	4	1.23	2.16
9	*Euphorbia hirta* L.	1.97	2	0.13	0.23
10	*Melastoma malabathricum* Auct. non L.	31.58	17	1.14	2.00

Note: AD: absolute density; RD: relative density; No = number of individual species/quadrant.

The high relative density, relative frequency and relative dominance of the *Paspalum conjugatum*, namely (26.16%), (9.66%) and (22.61%), were compared to other weeds because they had the most number of individuals found in each plot and their distribution. because the *Paspalum conjugatum* is almost always found in every plot on this cacao plantation so that the *Paspalum conjugatum* has the highest importance value and the SDR is (58.43%) and (19.48%). *Paspalum conjugatum* weeds which have relative density, high relative frequency and relative dominance are *Acystasia coromandeliana* (17.84%), (8.82%) and (19.83%).

This is because the number of individuals is found in each plot and has a wide distribution because *Acystasia coromandeliana* is almost found in every observation plot so that *Acystasia coromandeliana* has an important value and high SDR values, namely (46.49%) and (15.50%). Apart from *Paspalum conjugatum* and *Acystasia coromandeliana*,

other weeds that also have high SDR values are. *Clidemia hirta* (7.78%), *Axonopus compressus* (7.55%), *Eupatorium odoratum* (4.55%), *Ageratum conyzoides* (4.49%), *Imperata clyndrica* (3.45%), *Borreria alata* (2.78%), *Euphorbia hirta* (2.65%), and *Melastoma malabathricum* (1.87%).

This data shows that the distribution of these ten types of weeds is also wider compared to other types in the plantation, so that found on most of the sampling plots. The index of species diversity in cacao plantations from all types of weeds obtained was obtained by a diversity index value of 3.14. This value shows that the diversity of weeds on the plantation is very high. *Margurran* (2004) states that the Shannon diversity index value is divided into several criteria, namely H> 3.0 indicates very high diversity, H = 1.5-3.0 indicates high diversity value, H = 1.0-1.5 indicates moderate diversity and H <1 indicates low diversity. In addition, the large number of individual weeds on plantations on dry land (gardens) also affects the diversity index value. *Odum* (1996) states that the high and low diversity of an organism in its community depends on the number (number) of individuals present in the community. So it is suitable as a breeding ground for the *Paspalum conjugatum* which is so fast. So that with environmental factors like this the *Paspalum conjugatum* species is more dominant than other species (Table 2).

Imperata cylindrica (L) is the weeds in the planting area will disturb and reduce the production of a plantation. In general weeds can reduce the growth of plantation crops through competition for water and nutrients. Weeds can spread to plantations with generative through seeds and spores, however, some species of weeds can go through vegetatives such as stolons and rhizomes (Hamid, 2010). *Imperata cylindrica* an effective weed dispersing agent through water (hydrocores), animals (zookori), mamalia (mamakori) and wind (anemokori).

The principle of controlling the growth of weeds was by suppressing the population of weeds that are not affect to the farmers economically. Restoring all the weeds completely were in the different and limited places. Some of the methods were used to reduce the weeds including preventively control, mechanical control and technical control (Bukman, 2011).

Generally in the weeds in cocoa plantation at North Aceh Regency Province of Aceh Indonesia, the preventing control were done traditionally such as using simple tools (hoes, sickles, machetes and lawn mowers) and the chemical control was done by herbicides, in accordance with Bukman (2010) in Nelbessy Village farmers cloves controlling of weed by mechanical and traditional, with damaging parts of the weeds so that weeds die or stunted growth.

Conclusion

Weed flora of cacao fields was similar to that recorded in earlier surveys of fields. Weeds can be efficiently managed with herbicides under conventional cropping but represent a great problem under organic cropping in which implementation of mechanical weed control methods is advisable in order to reduce yield losses. Weeds cannot be regarded as a particular dis-incentive to planned expansion in pea production although they are expensive to control under conventional cropping and challenging to manage cropping.

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