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The Croton Plant Morphological Characteristics Diversity: Development of A Field Guide (Leaflet) for Morphometric Learning

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ABSTRACT

This research aims to compile and develop a frame of mind related to field guidance on croton plants in Morphometric courses. This is motivated by the absence of a specific field guide discussing croton plants, even though Morphometric courses require field practicum material. Documented the cultivars of croton plants (*Codiaeum variegatum*) spread across 4 districts in Manokwari and develop a field guide in the form of a leaflet of croton plant cultivars. The study was conducted using the ADDIE development model which is limited to 3 stages, namely Analysis, Design and Development. The subjects of the study were Biology Education Students. The research product was in the form of a croton plant leaflet that was validated by the material and media validator. Meanwhile, to test student responses, a questionnaire was used. The results of the UPGMA analysis grouped 26 cultivars into 3 groups, namely 6 narrow-leafed cultivars, 11 medium-leafed cultivars and 9 broad-leafed cultivars. This grouping is more influenced by leaf shape. The results of the analysis showed that there were 19 identical accessions (1.00). The results of the leaflet product validation for material experts were declared very valid (81.67%), and media experts were declared very valid (98.68%), in line with student responses stated as very practical (90.97%).

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1. INTRODUCTION

Indonesia is one of the tropical countries that has high biodiversity. Suwarso et al. (2019) define biodiversity as all forms of organisms found on land, water, and air in a certain space and time. Biodiversity is a provider of various natural resources and alternatives that can be used by the

community to meet their needs, including their use as ornamental plants. Ornamental plants are in great demand by the Indonesian people, this is evidenced by the large number of ornamental plants that can be found in the yards of houses in each region.

One type of ornamental plant that is often found is the croton plant (Codiaeum variegatum) or puring plant which has become one of the popular types of plants in recent years. According to Sukmawati et al. (2020) croton plants are one of the commodities that play an important role among the community because they can beautify or beautify the environment croton plants have very varied leaf shapes and colors. The leaves, which have a distinctive shape and color, attract people to collect croton plants (Armansyah & Simanjuntak, 2020). In addition, croton plants are also used for traditional medicine (Agustina et al., 2022; Njoya et al., 2021).

Mollick et al. (2011) reported that croton plants belong to the Euphorbiaceae family which has a very large number of species, of which there are more than about 300 varieties of croton in the world. The variety of croton varieties can be distinguished from very varied leaf colors and shapes, with leaf colors consisting of green, red, orange and yellow and the color variations are a combination of these basic colors (Gogahu et al., 2016). The leaf shapes possessed by croton plants include lanceolate, oval, oval, curved and jorong (Muzayyinah, 1970).

Field guide cards (leaflets) are printed media in the form of leaflets and are not booked, presented in small sizes, rectangular in shape and presenting complete information related to a specific product (Puspitasari et al., 2023; Wati et al., 2020). Media in biology teaching is needed to help students succeed in learning (Dita et al., 2023, 2024; Setyantoko et al., 2023), especially those that utilize local potential (Damopolii et al., 2019; Silahooy et al., 2024). Leaflets are printed media that contain writings and images related to a product (Pudyastuti, 2016). Leaflets are formed in a small piece of printed paper that can be folded into 2-3 pages. The leaflet contains information and messages. A leaflet is a printed media with a concise summary and real-life illustrations for children's easy recall of material (Antika et al., 2023). Learning morphometrics will be easier and more meaningful if it is equipped with a field guide card that can be used in learning activities to attract more students' attention. Lecturers must be creative in creating learning so that students are interested and understand the lessons being taught (Aprillia et al., 2025; Aristaningsih et al., 2025; Widyaningsih et al., 2019).

Based on the results of observations, there is still a lack of references from the results of the development of study objects locally, where from the analysis stage carried out through interviews with the instructors. It turns out that there are no research-based leaflets used in morphometrics courses, and generally using taxonomic textbooks, journals cause students to have difficulties in learning morphometric material easily and quickly in the field with the use of field guides (leaflets), because in terms of size it is practical to carry everywhere during learning outside the classroom. The purpose of this research is to document croton plant cultivar groups spread across 4 districts in Manokwari and develop them in the form of valid and practical field guides (leaflets) to be used in learning Morphometrics courses for students of the Department of Biology Education. The results of this research are expected to be used as a guideline for lecturers in the learning process and can motivate lecturers to use the surrounding environment as a place to learn, and especially for biology education students can use the resulting croton plant leaflets as a learning medium in the Morphometrics course.

2. METHODS

This research has been carried out in August-September 2024, in 4 (four) districts in Manokwari Regency with research and development, to produce products in the form of leaflets cultivar croton plants, which are developed with the ADDIE model (Branch, 2009), which is limited to 3 stages, namely Analysis, Design, Development. Tools and materials have been used, namely: rulers, cuttings, markers, 2B pencils, GPSMap Camera phone; hanging labels, transparent paper, HVS paper; specimens of Croton Plants; Tally sheet; Validation sheets of media and material aspects, questionnaire fibers for testing students' initial response to the paractization of the resulting leaflet products. The following is the flow of the stages of research carried out:

Research Procedure

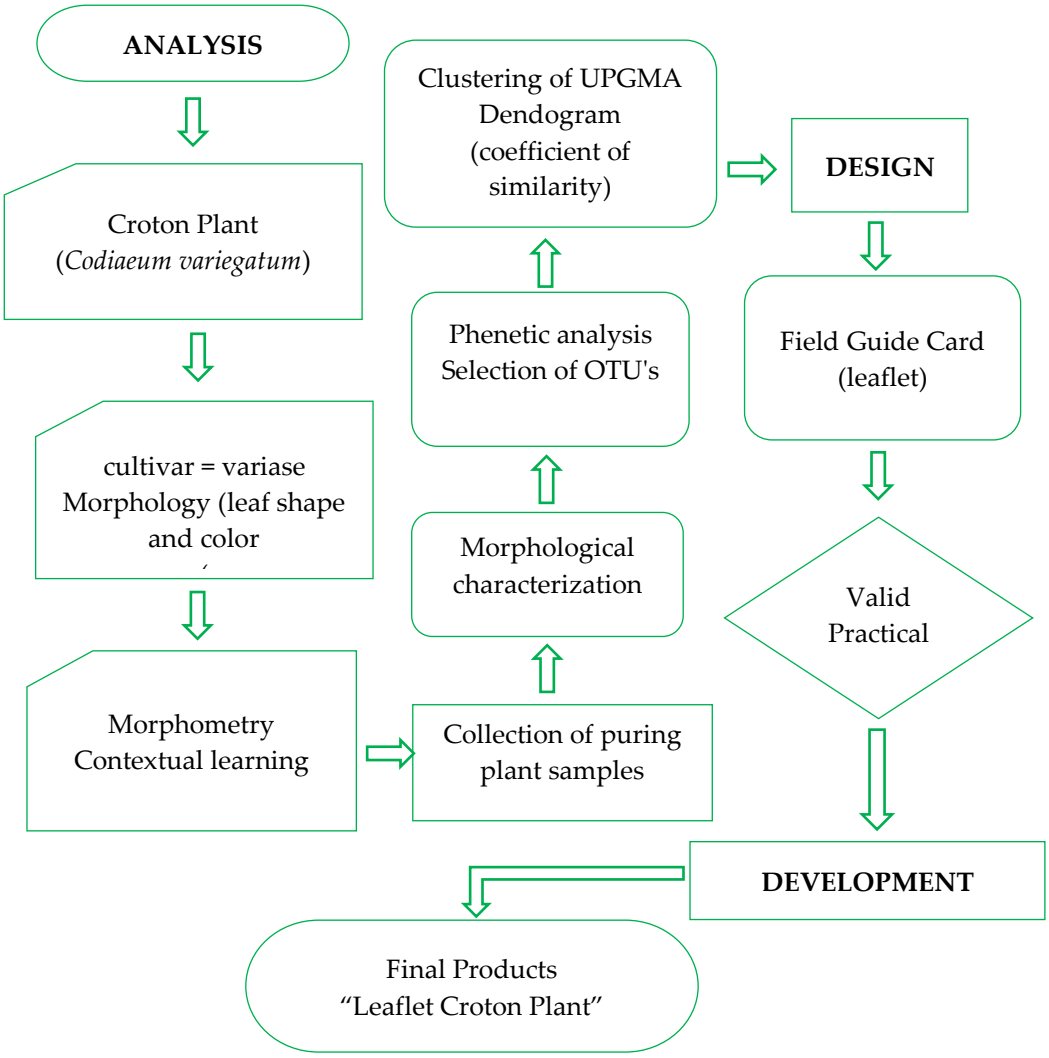

Figure 1. Stages of development of coroton plant Leaflet

Analysis Stage

The analysis stage is the initial stage of the development process in this study. What needs to be done at this stage is to identify the problems and needs of students with the limitations of the material to be developed, analyze learning outcomes by conducting interviews with lecturers in the Morphometrics. This problem needs to be developed in the form of teaching materials in the form of field guides (leaflets) to help biology education students understand. Learning the morphometrics course can be done by utilizing the potential for morphological variation of croton plants with contextual learning. After identifying the existing problems, direct observation will be made about croton plants around the Unipa campus yard and in the yard around the people's residences in Manokwari. Then the researcher will cut a leaf to be taken and used as a research sample and documented it.

Design Stage

After the analysis stage is completed, then the design stage or commonly called the design stage is carried out. At this stage, the design of the leaflet product as a whole is carried out and the brief material is compiled as the core part of the leaflet. Broadly speaking, the leaflet design of the cultivar of croton plants is explained in detail as follows:

1. The first part has a cover that contains the title, image of the croton plant, the name of the compiler, the logo of the agency or the name of the agency, the purpose and general description of the croton plant.
2. The core section contains the benefits of croton plants and information about the diversity of croton plant cultivars spread across 4 districts in Manokwari along with pictures of the plants.
3. The closing part contains an image in the form of a barcode scan that can be used to access a brief description of the croton plant cultivars obtained.

Development Stage

At this stage, the leaflet was developed based on the results of research on the diversity of croton plant cultivars in 4 districts in Manokwari. The data from the croton research obtained from the previous stage and the design stage were realized into a product in the form of *a* leaflet. The following are the stages of leaflet development in this study:

1. Creation of media for the diversity of croton plant cultivars in 4 districts in Manokwari. Leaflets are compiled using the Canva application and several free leaflet making sites that can be accessed on the internet such as wepik.com
2. Creating product validation questionnaires for material experts, media experts and trials limited to biology education students.
3. Validation, at this stage the initial product is validated by material experts and media experts. The purpose of this validation is to obtain an assessment in the form of suggestions and input from experts regarding the suitability of material and product design which is then used as a basis for revision or improvement.
4. Revision at this stage, the product is revised in accordance with the notes, inputs and suggestions from the validator to correct the weaknesses of the field guide in the form of leaflets. The revised results will be the final product of this research.
5. After validation, the next step is to find out the response of biology education students who have or are contracting morphometrics.

The data of the croton accessibility, morphological character matrix will be analyzed using the MVSP (Multivariate Statistical Package) program to obtain a dendogram UPGMA (unweighted pair-group method using arithmatic averages) according to Rolf (1998) and similarity coefficient according to Nei (1978). UPGMA is a simple hierarchical grouping (buttom up). A method for simple agglomerative to produce unbalanced results. Calculating the validity of teaching materials and students' responses using % (see Damopolii et al., 2022; Dita et al., 2023; Nasir et al., 2024).

3. FINDINGS AND DISCUSSION

The first step in conducting this research is to conduct a needs analysis. The needs analysis was carried out by the researcher based on the ADDIE development model. The researcher conducted a needs analysis with the lecturer in the morphometrics course. Next, the researcher conducted a survey of the research location and identified the croton plants and then included them in a leaflet. The researcher observes and identifies croton plants in the form of pictures/photos and also records each sample and coordinates on the tally sheet that has been prepared.

Based on several questions in Table 4 and observations about the leaflet , the researcher facilitated the leaflet on the diversity of croton cultivars to attract students to be more active in the learning process. From data collection in the field, it is known that there are 26 croton plant cultivars spread across 4 districts in the Manokwari City area.

Table 1. Diversity of croton plant cultivars in Manokwari

No	Croton Name Local	No Accessories	Location
1	Puring Hujan Emas	DA 01	West Manokwari
2	Puring Kecapi	DA 02	(UNIPA's old rectorate campus)
3	Puring Kirana	DA 03	
4	Puring Timun	DA 04	
5	Puring Jet	DA 05	
6	Puruing Zanzibar	DA 07	
7	Puring Apel	DA 08	
8	Puring Anting	DA 10	
9	Puring Wroten	DA 11	
10	Puring Jari	DA 14	South Manokwari
11	Puring Kerupuk	DA 17	(A Resident's Residence)
12	Puring Jazzy Hybrid	DA 18	
13	Puring Teri	DA 19	
14	Puring Lancur	DA 20	
15	Puring Teri Cabai	DA 21	
16	Puring Kura Batu	DA 24	North Manokwari
17	Puring Bor	DA 25	(Inodation village, residents'
18	Puring Dasi	DA 26	houses)
19	Puring Mawar	DA 34	West Manokwari (Amban Beach)
20	Puring Polkadot	DA 36	West Manokwari
21	Puring Lele garis merah	DA 37	(Jl. R&D of residents' houses)
22	Puring Cabai	DA 38	
23	Puring Mangkok	DA 43	East Manokwari (Jl. Bakaro)
24	Puring Katak	DA 56	West Manokwari
25	Breadfruit Puring	DA 57	(Mr. Jan Nunaki's house)
26	Puring Anting Raja	DA 58	

Table 2. Classification of croton plant cultivars

Group	No Accessions
Narrow-sized leaves	DA07, DA10, DA18, DA19, DA25, DA56
Medium-sized leaves	DA01, DA03, DA08, DA14, DA20, DA21, DA24, DA34, DA36, DA38, DA43
Large/wide leaves	DA02, DA04, DA05, DA011, DA017, DA28, DA37, DA57, DA58

The results of UPGMA's clustering grouped 26 croton plant cultivars into 3 groups consisting of 19 identical accessions with a coefficient of similarity of 1.00, and the most prominent accession separating itself from the subgroup was Jet croton with the shape of *hastate leaves*

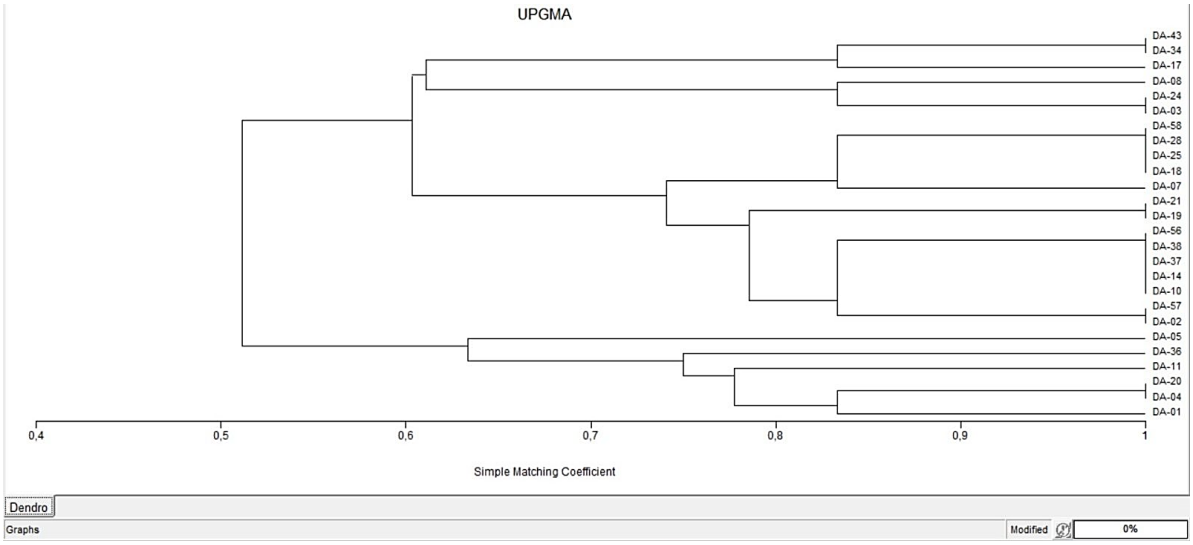

Figure 2. Dendogram 26 Accession of croton plants spread across 4 districts in Manokowari

The morphological diversity of croton leaves found in 4 districts in Manokwari was analyzed by looking at the similarity of the morphological characters of croton leaf sheets using MVSP which produced a similarity dendogram in cluster analysis, the coefficient showed similarity ranging from 0.5-1 and divided into 3 groups. Group I consists of 6 cultivars, namely DA-05, DA-36, DA-11, DA-20, DA-04 and DA-01. Jet cultivars (DA-05) separate themselves from other groups by a resemblance coefficient range of 0.6-0.7. While there are 2 identical cultivars (1.00), namely Lancur cultivar (DA-20) and Cucumber cultivar (DA-04).

Group II consists of 6 cultivars, namely DA-43, DA-34, DA-17, DA-08, DA-24 and DA-03. There are 4 identical cultivars (1.00), namely Mangkok cultivar (DA-43) and Mawar cultivar (DA-34); Stone Turtle cultivar (DA-24) and Kirana cultivar (DA-03). Meanwhile, the cultivar that separates itself from other groups is the Cracker cultivar (DA-17) in the character of green leaf color, red spot, rounded leaf base, notched leaf edges and parallel leaf growth. And the Apple cultivar (DA-08) is distinguished by the dominant green leaf color character of yellow spot, the shape of the pointed leaf tip and the shape of the base of the leaf tapered.

Group III has more identical cultivar subgroups as many as 14 cultivars (4 subgroups). Subgroup 1 consisting of DA-58, DA-28, DA-25 and DA-18 separates from DA-07 Zanzibar cultivars differing in all the starting characters of leaf colour, leaf shape, leaf base, leaf edge and leaf joint. There are 2 identical sub-groups of cultivars, namely Chili Anchovy (DA-21) and Anchovy cultivar (DA-19) in the character of leaf shape, leaf edges and leaf growth. Identical subgroup 3 consists of Frog cultivar (DA-56), Chili cultivar (DA-38), Red Line Catfish cultivar (DA-37), Finger cultivar (DA-14) and Earrings cultivar (DA-10) in the character of leaf tip, leaf base, leaf edge and leaf stem. The identical sub-group 4 consists of the Breadfruit cultivar (DA-57) and the Lyre cultivar (DA-02) on all the same characters.

At design stage, the researcher begins to design a product concept. At this stage, it has a format and does the initial design on the leaflet cover and the assessment instrument. The steps to make leaflets are as follows:

1. The first part has a cover that contains the title, image of the croton plant, the name of the compiler, the logo of the agency or the name of the agency, the purpose and general description of the croton plant.
2. The core section contains the benefits of croton plants and information about the diversity of croton plant cultivars spread across 4 districts in Manokwari along with pictures of the plants.
3. The closing part contains an image in the form of a barcode scan that can be used to access a brief description of the croton plant cultivars obtained.

The application design stage used through Canva and the website, paper size, letters, display, and image display. The design of the instrument and assessment of this preparation consisted of leaflet validation sheets for material experts and media experts, in addition to the preparation of student response assessment sheets was also carried out.

Figure 3. Croton plant leaflet

The developed leaflet is then validated by the validator. The researcher has two validators, namely validator I material expert and validator II media expert. The purpose of this validation is to determine the validation of the leaflet developed, based on the results of validators of material experts and media experts showing that the leaflet developed can be used with several revisions. Suggestions for improvement and criticism given by validator one, there are several suggestions for improvement from the leaflet that was developed, namely adding words arranged by the name of the researcher, naming the names of people in the contents of the leaflet being changed to residents and symbols in the name of the location were changed to letters. While the suggestions for improvement given by validator II there are several suggestions, namely in the name of the institution it is separated between FKIP and the University of Papua, then the name of the researcher is lowered under the title, in the writing croton is given all capital letters, followed by an explanation of the material from the word croton to the word varied. Then continued with a general picture of croton plants, and continued with advanced material ranging from the word diverse to the word indoor.

The validation of material experts on the material contained in the leaflet is assisted by validation sheets filled out by validators in the form of questionnaires. The statement in the validation sheet and the results of the validation of the subject matter expert. Table 3 show the results of the validation calculation of material experts.

Table 3. Material validator assessment results

No	Aspects assessed	Validity Value (%)	Criterion
1	content	79.16	Highly Valid
2	Construction	87.5	Highly Valid
3	Language	87.5	Highly Valid
4	Material	100	Highly Valid
	Average	81.67	Highly Valid

Validation leaflets consist of several aspects of assessment and questions related to the display of this media assessment using validation sheets filled in by validators, so that this media helps assess field guidelines that can be found to be feasible or not used. The results of the validation calculation can be seen in Table 4.

Table 4. Media validator assessment results

No	Aspects assessed	Validity Value (%)	Criterion
1	User Convenience	100	Highly Valid
2	Design	100	Highly Valid
3	Language	100	Highly Valid
4	Quality of Information	87.5	Highly Valid
5	Practicality	100	Highly Valid
	Average	98.68	Highly Valid

The results of student participants' responses on the respondent sheet aimed to see student responses after using a guide in the form of a reset-based leaflet on the cultivar material of croton plants that had been developed. The respondents totaled 18 student, as can be seen in Table 5 of the results of student responses.

Table 5. Student Response Results

No	Question	Valuation	
		%	Criterion
1	I can understand the content of the material well because the language used is light	94.44	Very Practical
2	I like to read the material because it is short, concise and clear to understand	93.06	Very Practical
3	I can clearly read the description of the material on the leaflet card	90.28	Sangat Praktis
4	Leaflets that have been developed are practical	95.83	Very Practical
5	Leaflets are interesting to read	88.89	Very Practical
6	I love reading leaflets, because of the interesting selection of typefaces and font sizes.	86.11	Very Practical
7	I was interested in reading leaflets, because there were interesting pictures and captions.	94.44	Very Practical
8	I became more understanding when I read the leaflet, because there are pictures and information to clarify each croton cultivar.	91.67	Very Practical
9	I can find out the cultivars of croton plants spread across 4 districts in Manokwari	88.89	Very Practical
10	The use of croton plant leaflets made it easier for me to understand the characteristics of croton because it is available in the surrounding environment.	88.89	Very Practical
11	Leaflets can be used in independent and group learning.	93.06	Very Practical
12	Barcode images are easily accessible	91.67	Very Practical
	Total	90.97	Very Practical

The assessment of the quality of leaflet development results in this study is determined by two criteria, namely validation and student response which are used as an assessment of the practicality of the leaflet. The leaflet validation developed is known based on the assessment of validator I and validator II to determine the feasibility of the leaflet. The leaflet validation examination was carried out before the researcher conducted a trial of leaflet products to students of the Department of Biology Education. Based on the assessment of validator I of the material expert reviewed from the material aspect, the leaflet includes information on the diversity of croton plant cultivars in 4 districts in Manokwari as many as 26 cultivars, the correctness of the content of the material submitted according to what happened, the terms that appear in the leaflet used appropriately, the preparation of the leaflet Starting from the cover, the content and cover are presented in a concise manner, the writing is clear and the font size is appropriate.

The images presented correspond to those in the field, the order in the material is appropriate, clarity to provide information, the diversity of croton plant cultivars is easy to understand. The results obtained from validator I material experts obtained an average score of 81.67% with very valid criteria. Based on validator II of media experts who reviewed the readability of the text, ease of use, background color design, language, quality of information and practicality of the leaflet can run well. The results obtained from validator II media experts obtained an average score of 98.68% with very valid criteria. According to Andini et al. (2025), leaflets that have been produced and have met valid criteria can be used for classroom teaching. This shows that the leaflet field guide development product is suitable for use in the learning process.

The leaflet is known from the results of the student response questionnaire can be seen from the leaflet that was developed to produce pictures, descriptions and brief descriptions so that students understand the terms contained in the leaflet. Students can understand the content of the leaflet well

because it uses the language used lightly, students like the pictures contained in the leaflet, practical and easy to go everywhere, interesting to read, easy to read because of the interesting type and size of letters and become more aware of the diversity of the bark of croton plants because there are pictures and brief descriptions on each croton plant cultivar.

One of the benefits of using leaflets in learning activities is to make learning activities easier and more effective and efficient (Agustini et al., 2024; Sari et al., 2021). Through the use of leaflets, it can also be used as motivational material to increase students' interest in learning, so that the learning process can be achieved optimally. The addition of color combinations to the design so as to give a pleasant atmosphere to the reader. Creating a more contextual learning atmosphere and providing a direct learning experience and attracting students' attention, stimulating students' curiosity about materials outside the classroom (environment) and learning resources that can be used by teachers and students. Based on Damopolii et al. (2024), the results of the response with a score of 81-100 were declared very practical. The overall score of student responses to the leaflet obtained an average score of 90.97% with very practical criteria. Therefore, leaflets developed in morphometrics courses can be used by students in the learning process

4. CONCLUSION

The results of UPGMA's clustering grouped 26 croton plant cultivars into 3 groups consisting of 19 identical accessions with a coefficient of similarity of 1.00, and the most prominent accession separating itself from the subgroup was Jet croton with the shape of hastate leaves. The field guide for croton plant leaflets developed based on the ADDIE model which discusses the cultivars of croton plants in Manokwari is very feasible and practical to be used in morphometrics courses based on the validation results of 81.67% material expert validators and 98.68% media expert validators with the "Very Valid" criteria; and based on the results of student responses reaching 90.97% with the "Very Practical" criterion so that it is stated that the leaflet that can be used in the learning process of morphometrics courses.

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