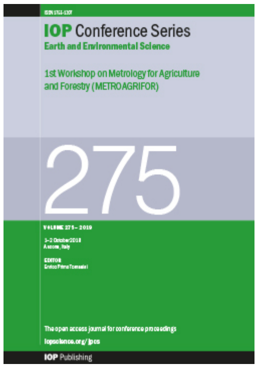

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PREFACE

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PREFACE

The 3rd ICoSA (International Conference on Sustainable Agriculture) 2020 was held in Universitas Muhammadiyah Yogyakarta (UMY), Indonesia on October 13-14, 2020. This conference was organized by Department of Agrotechnology, Faculty of Agriculture, UMY and the theme of this year conference was "**Resilient Agricultural Practices to Strengthen Food Security** " This conference has facilitated a mutual exchange of ideas and information from various backgrounds of stakeholder (either domestic or international) related to the utilization of recent technologies to support the agricultural activities sustainably. High enthusiasm coming from the participants of this conference was reflected by high number of good quality papers received.

Our committees are delighted to present this proceeding as a compilation of carefully selected papers representing each scope provided by the conference, such as crop production system (farming system, crop production and environment, biotechnology, plant breeding, agricultural mechanization), crop protection (entomology, phytopatology, weed science, pest management), management of land use (soil fertility analysis, waste management, and landscape), postharvest (product processing and development), and biodiversity.

We would like to express our gratitude to all parties who have sincerely supported and contributed to the success of the 3rd ICoSA 2020, either during the conference and the post-conference publication. We also would like to highly acknowledge the hard work and precious support from the organizing committee during the preparation until this conference has been fully finished.

We sincerely hope that this conference can be considered as a scientific forum providing high quality discussion among researchers and other related stakeholders in agricultural sectors. We belief that this proceeding may serve as an useful source of references for further studies which will contribute significantly for the future development of agricultural sectors.

Dr. Siti Nur Aisyah

Chairman of 3rd ICoSA 2020
Department of Agrotechnology, Faculty of Agriculture
Universitas Muhammadiyah Yogyakarta, Indonesia

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Sugarcane growth and yields in response to long-term monoculture practices under different soil orders

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Sugarcane growth and yields in response to long-term monoculture practices under different soil orders

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Abstract. Indonesia is the seventh largest sugar producer in the world. Monoculture sugarcane cultivation has been practiced since the Dutch era, especially in the Entisols, Inceptisols and Vertisols soil orders. The field research with this multilocation design aims to determine the effect of the monoculture sugarcane cultivation period (1–10, 11–20 and 21–30 years) on the growth and yield of sugarcane plants under the three soil orders. Analysis of variance (ANOVA) at a 5% significance and correlation was conducted to determine the effects of soil orders and monoculture period. The results showed that there were significant interactions between monoculture period and soil order on leaf fresh weight, leaf dry weight, root fresh weight, plant height, stalk diameters, number of stalks, leaf area, number of green leaf, root CEC, root length, root surface and root area. There was no interaction between monoculture period and soil order on stalk fresh weight, stalk dry weight, root dry weight, number of nodes. The sucrose content of sugarcane in Entisols at the 1–10 years monoculture period significantly lower (6.03%) compared to 11–20 years period (7.37%) and 21–30 year (7.79%), whereas at the 1–10 years monoculture period in Inceptisols and Vertisols (7.99% and 8.04 %) was significantly higher than that of Entisols (6.03%). Sugarcane productivity at monoculture period 1–10 years in Entisols significantly lowest (49.38 t/ha) compared to Inceptisols (54.82 t/ha) and Vertisols (63.05 t/ha) at the same period, while the 21–30 years period on Vertisols significantly highest (76.18 t/ha) compared to 11–20 years period (68.73 t/ha) and 1–10 years period (63.05 t/ha) in same soil order. These conditions indicate that the effect of long-term monoculture cultivation of sugarcane on the growth and yield of sugarcane varies, depending on the soil order as the grow medium and root parameters have the highest correlation with sugarcane yield. Land management to improve the root area is necessary for optimal plant growth.

1. Introduction

Sugarcane is a grass plant that has been cultivated in more than 90 countries in both tropical and subtropical countries. Sugarcane has a high economic value due to its role as a raw material in the sugar industry and an important ingredient for by-products such as brown sugar, molasses, cosmetics, as well as a substitute for fossil fuels for motor vehicles [1]. The history of sugarcane in Indonesia begins with the sugar industry using sugarcane as its raw material. This sugar industry has existed in Indonesia since the Dutch colonial. In 1925, it was reported that 201 sugar factories were operating in Java, which became the largest sugar supplier in the world in the mid-18th century [2]. This condition changed when

Indonesia became the largest sugar importer in the world in 2017-2018 due to the stagnant yields or productivity of sugarcane [3].

Sugarcane plants in Indonesia are widely cultivated in Java island [4] especially on Vertisols, Entisols, and Inceptisols [5]. As a tropical country, Indonesia has a high potential for sugarcane production. The area of sugar cane reaches 3,473,230 hectares, with a total production of about 2,854,300 tons [6]. Sugarcane in Indonesia is cultivated in a long-term monoculture. There have been many studies on the impact of monoculture cultivation on soil conditions due to the management system [7]. The longer period of monoculture leads to a decrease in soil pH, macronutrients [8] and micronutrients [9]. Meanwhile, the impact of monoculture on the soil physical properties includes an increase in soil bulk density and a decrease in porosity, thereby affecting soil aeration [10]. Besides, the C content also decreases due to a decrease in the number and activity of soil microorganisms, which is the determinant of soil biological properties [11]. Vertisols has good chemical fertility, such as having a high cation exchange capacity, a pH of 6-8.5, relatively high base saturation, high organic matter content, high N and CEC, and high P content [12]. Entisols has a low to neutral pH value, low organic matter, low clay content, low nutrient availability, and low CEC [13]. Meanwhile, Inceptisols has low weathering rate, low organic matter content, low N and P, low base saturation, and low CEC [12].

Monoculture of sugarcane in Indonesia has been carried out for a long period. However, there is no clear information regarding its impact on the growth and yield of sugarcane. This study aimed to determine the impact of monoculture cultivation of sugarcane in a long period (1–10 years, 11–20 years, and 21–30 years) on the growth and yield of sugarcane, especially in Java, Indonesia, on Inceptisols, Vertisols, and Entisols.

2. Materials and Method

2.1. Research location and Plant Analysis

This research was conducted at nine research sites that have the Am climate type (tropical monsoon) according to the Koppen-Geiger classification (Climate Data 2019) with an area of $100m^2$ each. The research was arranged in an oversite design with two factors, the soil order (Entisols, Inceptisols, and Vertisols) and the monoculture period of sugarcane cultivation (1–10, 11–20 and 21–30 years). Research locations representing Entisols and Vertisols are in Purworejo and Kulonprogo Regencies (Yogyakarta), while the research locations representing Inceptisolss are in Magelang, Central Java. The management of the sugarcane cultivation was following the system from the Madukismo Sugar Factory. The cultivar used was ratoon sugarcane cv. Bululawangan. The fertilizers applied were 250 kg ha^{-1} ZA and 200 kg ha^{-1} Phonska at two and six weeks after harvest, respectively, with a band placement system.

Analysis of the growth performance and yield of sugarcane was carried out during the 2018/2019 planting period when the plants were 11 months old. Plant samples were taken from each location, with a total of 30 plants per treatment used for plant analysis. The plant analysis included the fresh and dry weight of leaves, stalk, and root, root CEC observed using the ammonium chloride (NH_4Cl) saturation method [14], plant height, stalk diameter, number of stalks, number of nodal segments, number of green leaves, leaf area, root surface area, root length, and root area. The analysis of sugarcane yield included sucrose content and productivity. The sucrose content was obtained from the calculation of neera value x YF, in which the neera value (%) = Pol - 0.4 (Brix - Pol). Brix (%) is the percentage of sugar and non-sugar (%), Pol (%) is the percentage of sugar (%), YF is the yield factor (0.58), and 0.4 is conctanta. Meanwhile, the productivity was determined using the formula of MF x HF x PH x SF, in which MF = mound factor (950), HF = hole factor per mound (60), PH = plant height (m) and SF = stalk fresh weight per meter.

2.2. Data Analysis

The data obtained were analyzed using analysis of variance (ANOVA), followed by Duncan's multiple range test (DMRT) at 5% to compare the effects of the treatments. The analysis was performed using SAS 9.1.3. Portable, while the correlation analysis was performed using SPSS.

3. Results and Discussion

3.1. Sugarcane growth in different orders and periods of monoculture cultivation

The photosynthetic process of sugarcane follows the pattern of the C4 plant, which has a high level of photosynthetic efficiency under optimal environmental conditions. C4 plants are plants that have a maximum photosynthetic rate at a high light intensity and temperature [15]. Table 1 shows that there was an interaction effect of soil order and sugarcane monoculture period on the fresh and dry weight of leaves and the fresh weight of root, but no interaction effect on the fresh and dry weight of stalk and the dry weight of root. Sugarcane growth on Entisols with a monoculture period 1–10 years had the highest leaf dry weight (41.3 grams) compared to the dry weight on other orders in the same monoculture period. Different from the sugarcane planted in Inceptisols and Vertisols, the longer the monoculture period, the lower leaf dry weight value. This result shows that the field management period and soil order affect plant growth [16].

Table 1. Impact of the monoculture period and soil orders on leaf fresh weight, leaf dry weight, stalk fresh weight, stalk dry weight, root fresh weight, root dry weight.

Parameter	**Leaf fresh weight (g)**				**Leaf dry weight (g)**			
Treatment	MP1	MP2	MP3	Average	MP1	MP2	MP3	Average
Entisols	74.1 bc	49.5 cde	42.4 e	55.3	41.3 a	22.5 d	22.9 d	28.9
Inceptisols	44.8 de	122.2 a	71.0 cd	79.3	13.6 e	36.3 ab	39.3 ab	29.8
Vertisols	41.3 e	38.1 e	97.8 ab	59.1	14.3 e	25.8 cd	32.2 bc	24.1
Average	53.4	69.9	70.0	64.6 (+)	23.1	28.2	31.5	27.6 (+)
Parameter	**Stalk fresh weight (g)**				**Stalk dry weight (g)**			
Entisols	1602.2	1204.4	1512.2	1439.63 a	384.49	343.93	435.93	388.12 a
Inceptisols	1614.9	1580.1	1653.3	1616.1 a	428.76	356.53	436.13	407.14 a
Vertisols	1028.9	1165.6	1467.7	1220.72 b	314.43	273.39	402.83	330.22 b
Average	1415.3 ab	1316.7 b	1544.4 a	1425.48 (-)	375.89 ab	324.62 b	424.97 a	375.16 (-)
Parameter	**Root fresh weight (g)**				**Root dry weight (g)**			
Entisols	12.5 de	14.6 de	10.3 e	12.4	9.7	11.4	7.7	9.6 a
Inceptisols	21.9 bcd	34.7 a	19.4 cde	25.4	10.8	12.8	12.0	11.9 a
Vertisols	21.9 bcd	30.3 ab	26.7 abc	26.4	10.6	14.1	10.8	11.8 a
Average	18.8	26.5	18.8	21.4 (+)	10.4 ab	12.8 a	10.2 b	11.1 (-)

Remarks: (-) denotes no interaction effects between variables; (+) denotes interaction effects between variables. Values for the same parameter followed by the same lowercase letters are not significantly different according to DMRT 5%. MP1= monoculture period 1–10 y; MP2 = monoculture period 11–20 y; MP3 = monoculture period 21–30 y.

The stalk is a part of a plant that morphologically always grows and develops due to plant metabolic processes. The fresh and dry weight of sugarcane stalks obtained in Inceptisols and Entisols were almost the same, while in Vertisols, they were lower. The effect of the monoculture period on the fresh and dry weight of stalk showed that the highest fresh and dry weight of stalk were found in sugarcane plants cultivated on land with the longest period, which was 21–30 year. The soil orders did not significantly affect the dry weight of roots, while the monoculture period of 11–20 years resulted in the highest dry weight of roots. Root conditions are strongly influenced by soil texture, in which, the looser the soil, the better root development [17].

Plant height is one of the important variables observed to determine plant growth. Plant height is related to the absorption of nutrients and water, as well as the ability of plants to photosynthesize. Table

2 shows that there was an interaction effect of soil order and monoculture period on plant height and stalk diameter. Plant height decreased with the increasing of monoculture period in all soil orders. When compared between soil orders, the highest plant height was found in Inceptisols >Vertisols > Entisols. Stalk diameter is an important parameter that affects productivity [18] and the results showed that the largest stalk diameter was found in sugarcane planted on Entisols with a monoculture period of 1–10 years, which was significantly different from that in Vertisols and Inceptisols in the same monoculture period. This value is included in the medium criteria. Stalk diameter is influenced by nutrient conditions, both in the soil and from additional fertilizers [19].

Table 2. Impact of the monoculture period and soil orders on plant height, stalk diameter, number of stalks, number of nodes, number of green leaves, leaf area.

Parameter	**Plant height (cm)**				**Stalk diameter (cm)**			
Treatment	MP1	MP2	MP3	Average	MP1	MP2	MP3	Average
Entisols	215.2 cd	203.1 cde	196.1 de	204.8	3.36 a	2.82 b	2.90 b	3.03
Inceptisols	275.7 a	234.8 bc	228.2 bcd	246.2	2.67 bc	3.33 a	2.90 b	2.97
Vertisols	279.1 a	178.8 e	251.3 ab	236.4	2.42 cd	2.32 d	3.21 a	2.65
Average	256.7	205.6	225.2	229.13 (+)	2.82	2.83	3.00	2.88 (+)
Parameter	**Number of nodes**				**Number of stalks per clump**			
Entisols	15.9	17.6	19.0	17.5 b	4.28 b	5.67 a	4.17 b	4.70
Inceptisols	20.0	22.2	25.7	22.6 a	6.11 a	4.11 b	6.61 a	5.61
Vertisols	18.8	16.4	20.6	18.6 b	4.27 b	3.89 b	6.17 a	4.78
Average	18.2 b	18.7 b	21.7 a	19.57 (-)	4.89	4.56	5.65	5.03 (+)
Parameter	**Leaf area (dm^2)**				**Number of green leaves**			
Entisols	29.3 bc	18.5de	15.51 de	21.1	4.00 bc	3.24 d	3.58 cd	3.61
Inceptisols	10.9 e	32.4 ab	37.3 a	26.9	5.49 a	5.64 a	4.51 b	5.21
Vertisols	11.8 e	22.7 cd	28.1 bc	20.8	5.27 a	3.11 d	4.51 b	4.29
Average	17.4	24.5	26.9	22.9 (+)	4.92	4.00	4.20	4.37 (+)

Remarks: (-) denotes no interaction effects between variables; (+) denotes interaction effects between variables. Values for the same parameter followed by the same lowercase letters are not significantly different according to DMRT 5%. MP1 = monoculture period 1–10 y; MP2 = monoculture period 11–20 y; MP3 = monoculture period 21–30 y.

Sugarcane planted on Inceptisols soil had the highest number of nodes. Inceptisols soil has a better fertility rate compared to Entisols and Vertisols, thus providing better plant growth [20]. The monoculture period showed an impact on the number of nodal segments. Sugarcane planted in the monoculture period of 21–30 years produced the highest number of nodes. The nodal segments are influenced by the genetic factors of the varieties used [21]. Sugarcane cultivation in the long period will affect the physical and chemical properties of the soil [22], thereby affecting the growth of sugarcane.

Leaves are plant organs capturing sunlight to perform photosynthesis. There was an interaction effect of the soil order and sugarcane monoculture period on the number of green leaves and leaf area. The leaf area of sugarcane planted in Entisols decreased with a longer monoculture period (Table 2). Meanwhile, the leaf area of sugarcane planted in Inceptisols and Vertisols showed a significant increase with the increase in the monoculture period. The wider the surface area of a leaf, the more chloroplasts in the plant so that more sunlight is captured. Optimal capture of sunlight will accelerate the photosynthesis rate, thereby producing more photosynthate. Leaf area is an important variable to examine the physiological and agronomic sides concerning plant growth.

Root characteristics, including the value of root cation exchange capacity (CEC), root area, root length, and root surface area, were also affected by the interaction of soil orders and monoculture periods (Table 3). Root CEC is the ability of plant roots to absorb and exchange cations in soil solution. The adsorbed cations are usually available to plants by exchanging them with H^+ from plant root respiration. The sugarcane cultivated on Inceptisols with a monoculture period of 1–10 years had the highest CEC value (27.9 cmol (+)/kg). Meanwhile, in Inceptisols and Vertisols, the root CEC decreased with increasing monoculture periods. The uptake of plant phosphorus, potassium, iron, and manganese was significantly and positively correlated with root CEC. When associated with crop production, high root CEC will increase plant dry weight and plant productivity [23] due to increased absorption of nutrients such as N, P, and K [24].

The value of the root surface area is a function of root length and root diameter. The root surface area is related to the extent of water absorption by the root surface in the growing medium. Root surface area reflects the surface area of plant nutrient uptake and water in the soil. The wider the root surface area leads to the better the plant's ability to absorb nutrients and water in the soil [25]. The root area is strongly influenced by genetics and the environment [26]. The highest values of root surface area and root length were found in Entisols with a monoculture period of 1–10 years, whose value decreased with increasing monoculture period [17].

Table 3. Impact of the monoculture period and soil orders on CEC root, root surface area, root length and root area.

Parameter	**Root CEC (cmol$^{(+)}$/kg)**				**Root length (m)**			
Treatment	MP1	MP2	MP3	Average	MP1	MP2	MP3	Average
Entisols	15.4 c	14.1 c	23.0 ab	17.5	7.579 a	4.853 bcd	4.203 cde	5.545
Inceptisols	27.9 a	23.3 ab	14.1 c	21.8	2.699 de	5.623 abc	7.439 ab	5.253
Vertisols	27.5 ab	20.8 bc	25.4 ab	24.5	1.860 e	5.437 abc	2.718 de	3.338
Average	23.6	19.4	20.8	21.3 (+)	4.0459	5.304	4.786	4.712 (+)
Parameter	**Root surface area (m^2)**				**Root area (m^2)**			
Entisols	220.9 a	109.0 bc	77.4 bc	135.8	0.047 bc	0.033 c	0.024 c	0.035
Inceptisols	27.3 c	124.7 abc	182.5 ab	111.5	0.037 c	0.083 a	0.045 bc	0.055
Vertisols	13.2 c	107.6 bc	31.4 c	50.7	0.030 c	0.065 ab	0.030 c	0.042
Average	87.1	113.8	97.1	99.4 (+)	0.038	0.061	0.033	0.044 (+)

Remarks: (-) denotes no interaction effects between variables; (+) denotes interaction effects between variables. Values for the same parameter followed by the same lowercase letters are not significantly different according to DMRT 5%. MP1 = monoculture period 1–10 y; MP2 = monoculture period 11–20 y; MP3 = monoculture period 21–30 y.

3.2. Yield and productivity of sugarcane

The increase in sugar production can be influenced by the yield of the sugarcane obtained. Sugarcane yield is the value of the sugar content contained in sugarcane stalks. The increase in yield will be followed by an increase in sugar production. Besides the accumulation of sucrose in nodal segments, cell elongation also occurs during the maturation phase, thereby increasing the lignin formation and the thickness of the cell wall [27]. There was an interaction effect of soil order and monoculture period on the sucrose content (Table 4). The highest sucrose content was found in Vertisols with a monoculture period of 1–10 years (8.04%), which was significantly higher compared to that with a monoculture period of 11–20 years (6.79%) and 21–30 years (7.31%). There was a significant effect of soil order on the sucrose content with a monoculture period of 21–30 years, in which the sucrose content was higher in Entisols compared to in Inceptisols and Vertisols. In Entisols, the longer monoculture period increased the sucrose content. Conversely, in Inceptisols and Vertisols, the highest sucrose content was obtained in the monoculture period of 1–10 years, and the lowest was found in the monoculture period of 11–20 years. This shows that the impact of monoculture sugarcane cultivation on yield is highly dependent on soil order. Changes that occur due to monoculture sugarcane culture in the long term differ for each soil order. This condition is related to the ability of each soil to withstand the degradation that might occur. Soil properties such as physical, chemical and biological properties of soil have a role in determining the impact of land management on sugarcane yield [16].

Sugarcane production is influenced by various factors, such as the use of cultivation equipment and techniques. Increasing soil fertility is considered to increase sugarcane productivity and sugar production. Accordingly, the availability of nutrients in the soil, accompanied by management, is closely related to the level of productivity and yield of sugarcane. Soil is a part of production factors, including soil fertility, which has a positive effect on sugarcane production. Table 4 shows that there was an interaction effect of soil order and sugarcane monoculture period on sugarcane productivity. The highest productivity was found in sugarcane planted on Vertisols with a monoculture period of 21–30 years, reaching 76.18 t/ha, which was not significantly different from that grown on Inceptisols with a monoculture period of 21–30 years. The lowest productivity of sugarcane was found in sugarcane planted on Entisols with a monoculture period of 1–10 years, reaching 30.21 t/ha, which was not significantly different from that grown on Entisols with a monoculture period of 11–20 years. Land management plays a role in sugarcane productivity [28].

Table 4. Effect of monoculture periods on sucrose content and productivity on three soil orders.

Parameter	**Sucrose content (%)**				**Productivity (t/ha)**			
Treatment	MP1	MP2	MP3	Average	MP1	MP2	MP3	Average
Entisols	6.03 g	7.37 d	7.79 b	7.07	49.38 e	30.21 f	35.04 f	38.21
Inceptisols	7.99 a	6.80 f	7.57 c	7.45	54.82 d	62.29 c	73.06 ab	63.39
Vertisols	8.04 a	6.79 f	7.13 e	7.32	63.05 c	68.73 b	76.18 a	69.32
Average	7.36	6.99	7.49	7.28 (+)	55.75	53.74	61.43	56.97 (+)

Remarks: (-) denotes no interaction effects between variables; (+) denotes interaction effects between variables. Values for the same parameter followed by the same lowercase letters are not significantly different according to DMRT 5%. MP1 = monoculture period 1–10 y; MP2 = monoculture period 11–20 y; MP3 = monoculture period 20–30 y.

3.3. Relationship between yield and plant growth

The relationship between yield and plant growth of sugarcane was presented in Table 5. The dry weight of leaves, root surface area, and root length have a strong correlation with sucrose content, with r values of -0.748 *, -0.696 *, and -0,660, respectively. Meanwhile, the fresh weight of leaves, root CEC, plant height, stalk diameter, and root area show a strong enough correlation with sucrose content with r values of -0.477, 0.468, 0.477, -0.547, and -0.565, consecutively. Table 5 also shows that the fresh weight of roots has a strong and significant correlation with sugarcane productivity (r = 0.699*). The other plant growth variables, such as the dry weight of roots, the number of nodal segments per stalk, and the number of green leaves show a strong enough correlation with sugarcane productivity with r values of 0.538, 0.464, 0.406, and 0.407, respectively.

Root cation exchange capacity (root CEC) is an important variable in determining the plant's response to existing environmental conditions. Besides, the root CEC is considered important because the higher the root CEC, the higher the total root absorption surface, so that the roots can take more nutrients for plants [29]. The uptake of phosphorus, potassium, iron, and manganese was significantly and positively correlated with root CEC. When associated with crop production, high root CEC will increase plant dry weight and plant productivity [23] due to increased absorption of nutrients, such as N, P, and K [24].

The number of nodal segments per stalk has an important effect on yield because it has a relationship with plant height. Primarily, the height of the sugarcane plant is determined by the number of nodal segments and the stalk length, in which the elongation of the nodal segments occurs during the stalk elongation. This strong and positive correlation indicates that the higher number of nodal segments per stalk, the greater the yield of sugarcane [30].

The rate of plant photosynthesis is influenced by the presence of chlorophyll in leaves. The high content of chlorophyll will increase the photosynthesis rate, thereby improving the growth and productivity of sugarcane [31]. Besides, leaves also play a role in capturing sunlight for photosynthesis. The wider the leaf surface area, the more chloroplasts contained in the plant so that more sunlight is captured. Optimal sunlight capture will accelerate the photosynthesis rate, producing more photosynthate and optimal productivity [32].

Table 5. Correlation between growth parameters and yield

Parameter	Sucrose content	Productivity
Leaf fresh weight	-0.477	0.383
Leaf dry weight	-0.748*	0.290
Stalk fresh weight	-0.206	0.070
Stalk dry weight	0.266	-0.112
Root fresh weight	-0.147	0.699*
Root dry weight	-0.265	0.538
CEC root	0.468	0.265
Plant height	0.477	0.351
Stalk diameter	-0.547	-0.059
Number of stalks per clump	0.355	0.210
Number of nodes	0.358	0.464
Number of green leaves	0.289	0.406
Leaf area	0.346	0.407
Root surface area	-0.696*	-0.088
Root lenght	-0.660	-0.031
Root area	-0.565	0.340

*. Correlation is significant at the 0.05 level (2-tailed).

The strongest correlation was seen between sugarcane productivity and the fresh and dry weight of roots. This result shows that the root area (rhizosphere) has a major role in sugarcane productivity. Roots are the important parts of the plant in determining productivity because root conditions determine the sufficiency of nutrients and water for plants [29]. here was a positive correlation between the dry weight of roots and water consumption, in which the higher the fresh and dry weight of the roots, the higher the water consumption. Meanwhile, water consumption correlated with the plant leaf area, in which the wider the leaf surface area, the more chloroplasts contained in the plant, so that more sunlight is captured, increasing the photosynthesis rate [33].

The variables of root performance, such as the fresh and dry weight of roots, root CEC, and root surface area, have a strong enough to very strong correlation with sugarcane yield and productivity. Some of the roles of the root system on sugarcane yields include the role in up taking nutrients for plants, as well as in the process of gas exchange, transpiration, and plant assimilation [34]. Roots can indirectly contribute to the accumulation of organic substrates, growth, and accumulation of plant dry matter [35]. Root environmental conditions such as soil physical, chemical, and biological properties have a role in increasing the assimilation process, so that soil conditions need to be considered to achieve sustainable and optimal yield and productivity of sugarcane [36].

4. Conclusion

The yield of sugarcane grown in Entisols in the sugarcane monoculture period of 21-30 years was higher than in the 11-20 years and 1-10 years period, but the productivity value was lower. Sugarcane grown in Inceptisols and Vertisols has a higher sugarcane yield in the monoculture period of 1-10 years compared to 11-20 years and 21-30 years, but the productivity value was greater. This condition was influenced by sugarcane growth that influenced by the interaction between soil order and sugarcane monoculture periods such as leaf fresh weight, leaf dry weight, root fresh weight, plant height, stalk diameters, number of stems, leaf area, number of green leaves, CEC root, root length, roof surface, and root area. Root parameters have the highest correlation with sugarcane yields so that the root area needs to be considered in its management, not only the problem of adequate fertilization with inorganic fertilizers, but root area management such as organic matter or organic fertilizers and soil processing are also needed, so that roots can grow well.

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SURAT TUGAS

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Direktur Politeknik LPP menugaskan kepada Dosen Tetap Politeknik LPP yang tersebut pada lampiran surat ini untuk melaksanakan kegiatan penelitian dan publikasi ilmiah ke seminar atau jurnal nasional maupun internasional selama tahun akademik 2020/2021 genap mulai tanggal 1 Maret 2021 hingga 17 Juli 2021. Selanjutrnya berkoordinasi dengan UPPM Politeknik LPP dalam hal pelaksanaan dan pelaporan, hingga penulisan artikel yang akan dipublikasikan.

Demikian agar dilaksanakan dengan sebaik-baiknya.

Yogyakarta, 22 Februari 2021
Direktur,

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