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Research Article
Yield Component Evaluation of Hybrid Maize Genotypes Applied with Cattle Manure Compost

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Abstract
Background and Objective: Maize is an important crop in the world. Using hybrid genotype and organic fertilizer input is an alternative solution to increase productivity. This research aims to determine and analyze the effect of various doses of cattle manure compost on the production components of various hybrid corn genotypes. **Materials and Methods:** This research was arranged in a split-plot design. The main plot, namely the compost dose, consists of 0, 2 and 4 ton ha^{-1}. The subplots, namely corn genotypes, consist of MAL 03/P2, P2/P6, JH 29, G102612/P7, JH 34 (V5), PAC 225-5-8/Mpop 24, B11209/Avln 864, Nasa 29 and JH 33. The observation parameters included cob weight (kg), cob diameter (mm), cob length (cm), length of filled cob (cm), number of seed rows, weight of 1000 seeds (g), chlorophyll a (µmol m^{-2}), chlorophyll b (µmol m^{-2}), total chlorophyll (µmol m^{-2}), stomatal opening area (µm^{2}) and productivity(ton ha^{-1}). **Results:** The application dose of cow dung compost increases, the growth and production of corn plants also increase. The productivity component is supported directly by cob weight, with a strong correlation value of 0.85. The highest corn productivity in applying 4 ton ha^{-1} of cattle manure compost was recorded in the JH 29 genotype, 12.54 ton ha^{-1}. In comparison, the JH 33 genotype in the application of 0 ton ha^{-1} of cattle manure compost recorded a productivity of 12.33 ton ha^{-1}. **Conclusion:** Results concluded that JH 29 and JH 33 genotypes identify as the genotype with the highest production compared to other genotypes at various compost application doses.

Key words: Maize, cattle manure, compost, productivity, genotype, hybrid, yield

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Maize (*Zea mays*) is a major crop grown around the world. Because of its rapid growth rate, nutritional value and adaptability to a wide range of environmental conditions, it has become an essential components of the global agricultural system[1]. Maize is one of the most important food in Indonesia, because it has a strategic role in the national economy. Almost all parts of the maize plant can be utilized for various needs, both as a source of staple food after rice and as a necessity of industrial raw materials[2,3]. The extent of maize utilization makes the demand for maize continue to increase yearly. Indonesia's maize production has been below target from 2016 to 2020.

One way to increase the yield of maize crops is to use seeds that are high in quality through the utilization of hybrid maize genotypes to produce superior varieties obtained from the cultivation process[4]. Using superior varieties of seeds in the cultivation of maize crops is one supporting factor in increasing national maize productivity because it has the potential to yield significantly superior to those of the free-range varieties. However, the seeds of the hybrid maize that currently dominates the national market are seeds from outside Indonesia. Therefore, it is necessary to create superior varieties by evaluating appropriate criteria from several hybrid maize genotypes[5,6].

Increasing maize yields by using high-yielding seed varieties is not enough to support high production. It is also necessary to apply manure or fertilizers so that plant nutrition needs can be fulfilled. Fertilization has a direct effect on soil maintenance and aims to restore the state of nutrients. Retrieval of nutrients continuously through crop yields without being balanced by the return of nutrients through fertilization makes the soil poorer in nutrients. The combination of organic and inorganic fertilizers can significantly increase the growth of plant, also contributed to the soil's physicochemical properties[7,8]. One of the organic fertilizers that can be used is compost because, in addition to readily available materials, it can maintain soil balance and improve soil quality sustainably[9].

Organic fertilizers such as compost can be obtained from the manure of ruminant animals, such as cattle. Every day, cattle produce a lot of manure that can be processed into compost, which provides many benefits[10]. Cattle/cattle dung is a prevalent organic waste and its treatment and utilization play a significant role in environmental protection and agricultural production[11]. Cattle dung contains 0.4-1% nitrogen, phosphorus 0.2-0.5%, potassium 0.1-1.5%, moisture content 85-92% and some elements such as Ca, Mg, Mn, Fe, Cu and Zn so that it has the potential to be composted[12]. Compost from cattle dung can improve soil density and increase plant yield[13]. Application of cow dung compost with different doses on maize plants gave results that had a genuine effect on growth and yield because it increases P uptakes from the soil by maize plants[14].

Based on the description above, this research aims to determine and analyze the effect of various doses of cattle manure compost on the production components of various hybrid corn genotypes, so that genotypes that are responsive and have optimal growth and production can be obtained when applying cattle manure compost.

MATERIALS AND METHODS

Study area: This research was conducted at the Teaching Farm, Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia. The research location is 22.4 m above sea level and the average temperature is 24°C in the morning and 32°C in the afternoon. Rainfall when the research was conducted in the field ranged from 143-1029 mm per month. This research was carried out from September, 2022 to February, 2023. The characteristics of the research soil were described in Table 1.

Experimental design: This research was arranged in a split-plot design. The main plot, namely the compost dose, consists of 0, 2 and 4 ton ha^{-1}. The subplots, namely corn genotypes, consist of MAL 03/P2, P2/P6, JH 29, G102612/P7, JH 34 (V5), PAC 225-5-8/Mpop 24, B11209/Avln 864, Nasa 29 and JH 33. From these two factors, 27 treatment combinations were obtained, which were repeated three times. The chemical characteristics of compost were described in Table 2.

Table 1: Soil characteristics

Parameter	Characteristics
Texture	Clay silt
pH	5.95
C	1.10%
N	0.16%
C/N	7
P_2O_5	9.28 ppm
Ca	4.91 cmol kg^{-1}
Mg	0.69 cmol kg^{-1}
K	0.28 cmol kg^{-1}
Na	0.13 cmol kg^{-1}
CEC	20.97 cmol kg^{-1}

Table 2: Cattle manure compost characteristics

Parameter	Characteristics
pH	6.86
C	15.25%
N	0.55%
C/N	28
P	0.15%
K	0.32%

Cultivation process: Before making the beds, the research land was loosened using a tractor. After that, a bed is made measuring 3×5 m. The seeds were healthy, physically and genetically protected. The application of cattle manure compost was carried out according to the predetermined treatment, consisting of 0 ton ha^{-1} (without application), 2 ton ha^{-1} (3 kg/plot) and 4 ton ha^{-1} (kg/plot). Planting is done by making holes in each bed. Each planting hole was filled with two corn seeds. Watering is done twice a day, namely in the rise and in the afternoon. Fertilization was carried out three times, namely at the age of 10 DAP (7 g NPK, 2.1 g SP-36 and 1.1 g urea), 30 DAP (7 g NPK and 1.1 g urea) and 50 DAP (1.1 g urea) by sowing nearby plant roots. After seven days, the plants were selected so that only one plant is left per planting hole. Weeding is done physically by pulling weeds using hands. The harvesting process is carried out after the cobs are entirely formed and show the characteristics of physiological maturity. After the harvesting process, measurements of various parameters were carried out.

Data collecting and analysis: The observation parameters included cob weight (kg), cob diameter (mm), cob length (cm), length of filled cob (cm), number of seed rows, weight of 1000 seeds (g), chlorophyll a (µmol m^{-2}), chlorophyll b (µmol m^{-2}), total chlorophyll (µmol m^{-2}), stomatal opening area (µm2) and productivity (ton ha^{-1}). All data was analyzed for variance to determine the effect of treatment. If there is an interaction between the two treatments, then an LSD $\alpha = 0.05$ test was carried out to determine the differences in each corn genotype at each dose of cattle manure application. Correlation analysis was carried out to determine the relationship between various observation parameters. The entire data analysis process was carried out in R Studio (2022.7.2.576, Spotted Wakerobin, Boston, Massachusetts).

RESULTS

Cob traits: The interaction between genotype and cattle manure application had a significant effect on corn cob weight and cob diameter (Table 3). Each corn genotype tested had a different effect on the various doses of manure applied. The JH 33 genotype showed the highest cob weight without manure application (24.80 kg), with a percentage increase of 60%, compared to the JH 29 genotype, which had the lowest cob weight. In the application of 2 ton ha^{-1} of manure, it was recorded that the P2/P6 genotype had the highest cob weight (23.33 kg) with a percentage increase of 32.03%, compared to the PAC 225-5-8/Mpop 24 genotype, which had the lowest cob weight. Then, the JH 29 genotype at a dose of 4 ton ha^{-1} recorded the highest ear weight (24.83 kg) with a percentage increase of 28.18%, compared to the MAL 03/P2 24 genotype, which had the lowest ear weight.

The P2/P6 genotype had the widest cob diameter without manure application (49.53 mm), which was 17.59% wider than the MAL 03/P2 genotype, which had the most minor cob diameter. However, with the application of 2 ton ha^{-1} and 4 ton ha^{-1} of manure, the results showed that the JH 34 (V5) genotypes recorded the widest ear diameters (50.09 mm and 51.46 mm), respectively, which were 13.86% and 13.42% wider than the genotype Nasa 29 at a dose of 2 ton ha^{-1} and MAL 03/P2 at a dose of 4 ton ha^{-1}.

The interaction between genotype and cattle manure application had a significant effect on ear length and seed ear length (Table 4). Each corn genotype tested had a different effect on the various doses of manure were applied. The JH 33 genotype showed the most extended cob length without manure application (19.89 cm), 16.86% longer than the PAC 225-5-8/Mpop 24 genotype, which had the shortest cobs. In the application of 2 ton ha^{-1} of manure, it was recorded that the P2/P6 genotype had the longest cobs (20.53 cm), which was 8.22% longer than the B11209/Avln 864 genotype, which had the shortest cobs. Then, the JH 33 genotype at a dose of 4 ton ha^{-1} recorded the longest cobs (22.41 cm), 12.23% longer than the B11209/Avln 864 genotype, which had the shortest cobs.

When observing the length of filled cobs, the results showed that the JH 33 genotype had the most extended filled cob length at application doses of 0 ton ha^{-1} and 4 ton ha^{-1} of manure (18.71 cm and 20.19 cm), which were 34.31% and 48.56% more filled than genotype B11209/Avln 864. When applying 2 ton ha^{-1} of manure, the result was that the Nasa 29 genotype recorded the longest-filled cob length (17.69 cm), which was 27.72% longer than G102612/P7, which had the shortest filled cob length.

Seed traits: The interaction between genotype and cattle manure application had a significant effect on the number of rows of seeds and the weight of 1000 seeds (Table 5). The JH 29 genotype consistently recorded the highest number of rows of seeds at all cattle manure application doses (16.13, 16.27 and 16.27), which were 24.82, 24.48 and 20.25% more than MAL 03/P2 at a dose of 0 ton ha^{-1}, Nasa 29 at doses of 2 ton ha^{-1} and 4 ton ha^{-1}.

The G102612/P7 genotype showed the heaviest 1000 seed weight without manure application (381.55 g),

Table 3: Interaction effect of cattle manure compost and genotypes on cob weight and cob diameter

	Cob weight (kg)			Cob diameter (mm)		
Genotype	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}
MAL 03/P2	19.57^{q}	19.00^{pq}	19.37^{q}	42.12^{r}	45.76^{q}	45.37^{r}
P2/P6	18.07^{q}	23.33^{p}	20.50^{pq}	49.53^{p}	48.84^{p}	46.18^{qr}
JH 29	15.50^{q}	18.43^{q}	24.83^{p}	47.09^{pq}	48.65^{pq}	46.71^{qr}
G102612/P7	21.83^{pq}	22.30^{pq}	21.83^{pq}	46.41^{q}	44.04^{q}	46.40^{qr}
JH 34 (V5)	21.60^{pq}	21.10^{pq}	21.83^{pq}	48.73^{pq}	50.09^{p}	51.46^{p}
PAC 225-5-8/Mpop 24	15.53^{q}	17.67^{q}	21.83^{pq}	47.44^{pq}	47.75^{pq}	47.73^{qr}
B11209/Avln 864	22.90^{pq}	19.53^{pq}	22.50^{pq}	47.58^{pq}	48.33^{pq}	48.49^{q}
Nasa 29	20.07^{q}	17.90^{q}	19.57^{q}	45.90^{q}	43.99^{q}	45.85^{r}
JH 33	24.80^{p}	19.03^{pq}	20.33^{pq}	47.25^{pq}	46.33^{q}	49.48^{pq}

Means followed by the same letter are not significantly different for $p \leq 0.05$ according to LSD

Table 4: Interaction effect of cattle manure compost and genotypes on cob length and length of filled cob

	Cob length (cm)			Length of filled cob (cm)		
Genotype	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}
MAL 03/P2	17.53^{r}	19.86^{pq}	20.71^{q}	16.36^{q}	16.51^{pq}	15.65^{r}
P2/P6	18.83^{q}	20.53^{p}	20.21^{qr}	17.43^{pq}	15.21^{q}	17.71^{q}
JH 29	17.56^{r}	19.65^{q}	19.79^{qr}	14.53^{qr}	15.70^{pq}	13.75^{rs}
G102612/P7	19.06^{q}	20.65^{p}	21.64^{p}	15.68^{qr}	13.85^{q}	16.35^{qr}
JH 34 (V5)	16.94^{r}	19.53^{q}	20.38^{qr}	14.74^{qr}	15.35^{q}	16.22^{qr}
PAC 225-5-8/Mpop 24	17.02^{r}	19.41^{q}	20.44^{qr}	14.47^{qr}	15.76^{pq}	17.05^{qr}
B11209/Avln 864	17.37^{r}	18.97^{q}	19.95^{qr}	13.93^{r}	14.61^{q}	13.59^{s}
Nasa 29	17.63^{r}	19.42^{q}	20.18^{qr}	16.38^{q}	17.69^{p}	18.19^{pq}
JH 33	19.89^{p}	20.43^{pq}	22.41^{p}	18.71^{p}	16.77^{pq}	20.19^{p}

Means followed by the same letter are not significantly different for $p \leq 0.05$ according to LSD

Table 5: Interaction effect of cattle manure compost and genotypes on number of seed rows and weight of hundred seeds

	Number of seed rows			Weight 1000 seeds (g)		
Genotype	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}
MAL 03/P2	12.93^{s}	13.20^{s}	13.60^{r}	353.80^{p}	340.42^{pq}	316.13^{q}
P2/P6	15.20^{q}	14.40^{r}	14.27^{qr}	353.22^{p}	360.18^{pq}	357.03^{pq}
JH 29	16.13^{p}	16.27^{p}	16.27^{p}	350.50^{p}	315.90^{q}	389.36^{p}
G102612/P7	14.00^{r}	14.00^{rs}	14.20^{qr}	381.55^{p}	329.28^{pq}	370.34^{pq}
JH 34 (V5)	15.07^{q}	15.93^{pq}	14.80^{q}	380.50^{p}	319.97^{pq}	347.03^{pq}
PAC 225-5-8/Mpop 24	14.13^{r}	15.33^{q}	15.47^{pq}	368.71^{p}	310.02^{q}	384.99^{p}
B11209/Avln 864	15.47^{pq}	15.47^{pq}	15.47^{pq}	359.65^{p}	357.56^{pq}	371.94^{pq}
Nasa 29	13.60^{rs}	13.07^{s}	13.53^{r}	356.86^{p}	344.92^{pq}	385.69^{p}
JH 33	13.47^{rs}	13.33^{s}	14.13^{qr}	347.39^{p}	365.97^{p}	329.94^{q}

Means followed by the same letter are not significantly different for $p \leq 0.05$ according to LSD

9.83% heavier than the JH 33 genotype, which had the lightest 1000 seed weight. In the application of 2 ton ha^{-1} of manure, it was recorded that the JH33 genotype had the heaviest 1000 seed weight (365.97 g), which was 18.04% heavier than the PAC 225-5-8/Mpop 24 genotype, which had the lightest 1000 seed weight. Then, the JH 29 genotype at a dose of 4 ton ha^{-1} recorded the heaviest 1000 seed weight (389.36 g), 23.16% heavier than the MAL 03/P2 genotype, which had the lightest 1000 seed weight.

Chlorophyll and stomata trait: The interaction between genotype and cattle manure application had a significant effect on chlorophyll a and b levels (Table 6). Each corn genotype tested had a different effect on the various doses of manure applied. The PAC 225-5-8/Mpop 24 genotype showed the highest chlorophyll a without manure application (346.40 µmol m^{-2}), which was 22.17% higher than the JH 34 (V5) genotype, which had the lowest chlorophyll a. In the application of 2 ton ha^{-1} of manure, the B11209/Avln 864 genotype had the highest chlorophyll a (340.42 µmol m^{-2}), which was 12.01% higher than the JH 33 genotype, which had the lowest chlorophyll a content. Then, the P2/P6 genotype at a dose of 4 ton ha^{-1} recorded the highest chlorophyll a content (157.52 µmol m^{-2}), which was 23.50% higher than the JH 29 genotype, which had the lowest chlorophyll a.

Table 6: Interaction effect of cattle manure compost and genotypes on chlorophyll a and b

	Chlorophyll a (µmol m^{-2})			Chlorophyll b (µmol m^{-2})		
Genotype	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}
MAL 03/P2	318.97^{q}	328.06^{pq}	316.38^{qr}	138.12^{q}	145.14^{pq}	136.89^{qr}
P2/P6	333.98^{pq}	338.50^{pq}	347.40^{p}	148.77^{pq}	153.47^{p}	157.94^{p}
JH 29	319.21^{q}	336.78^{pq}	281.29^{s}	138.54^{q}	150.40^{pq}	114.92^{s}
G102612/P7	308.67^{q}	311.69^{q}	310.63^{r}	132.84^{q}	133.78^{q}	133.21^{r}
JH 34 (V5)	283.68^{r}	336.70^{pq}	336.67^{pq}	118.15^{r}	150.20^{pq}	150.22^{pq}
PAC 225-5-8/Mpop 24	346.40^{p}	320.94^{q}	330.72^{pq}	157.32^{p}	139.85^{q}	146.41^{pq}
B11209/Avln 864	333.47^{pq}	340.42^{p}	329.40^{q}	149.23^{pq}	153.70^{p}	145.63^{q}
Nasa 29	324.46^{q}	316.54^{q}	330.30^{pq}	142.29^{q}	137.73^{q}	146.15^{q}
JH 33	331.07^{pq}	303.90^{q}	339.86^{pq}	147.41^{pq}	129.54^{q}	153.39^{pq}

Means followed by the same letter are not significantly different for $p \leq 0.05$ according to LSD

Table 7: Interaction effect of cattle manure compost and genotypes on chlorophyll total and stomata opening area

	Chlorophyll total (µmol m^{-2})			Stomata opening area (µm^{2})		
Genotype	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}
MAL 03/P2	459.34^{q}	472.94^{pq}	455.31^{q}	17.79^{pq}	33.49^{p}	14.65^{rs}
P2/P6	481.71^{pq}	488.97^{p}	501.89^{p}	20.41^{p}	20.93^{q}	17.01^{rs}
JH 29	459.48^{q}	485.84^{pq}	398.89^{r}	15.96^{q}	17.27^{qr}	18.32^{r}
G102612/P7	444.10^{q}	448.28^{q}	446.73^{pq}	19.10^{pq}	16.75^{r}	26.17^{q}
JH 34 (V5)	407.27^{q}	485.69^{pq}	485.65^{pq}	13.61^{q}	17.53^{qr}	25.12^{q}
PAC 225-5-8/Mpop 24	501.16^{p}	462.12^{pq}	476.78^{pq}	12.04^{q}	17.27^{qr}	13.08^{s}
B11209/Avln 864	481.18^{pq}	491.55^{p}	474.83^{pq}	14.39^{qr}	15.96^{r}	22.50^{q}
Nasa 29	467.42^{pq}	455.78^{pq}	476.16^{pq}	11.78^{r}	17.79^{qr}	15.70^{rs}
JH 33	477.52^{pq}	436.91^{q}	490.73^{pq}	13.61^{q}	15.96^{r}	59.92^{p}

Means followed by the same letter are not significantly different for $p \leq 0.05$ according to LSD

Similar results were also seen for chlorophyll b levels. The PAC 225-5-8/Mpop 24 genotype showed the highest chlorophyll b content without manure application (346.40 µmol m^{-2}), which was 33.32% higher compared to the JH 34 (V5) genotype, which had the lowest chlorophyll b content. In the application of 2 ton ha^{-1} of manure, it was recorded that the B11209/Avln 864 genotype had the highest chlorophyll b content (153.70 µmol m^{-2}), which was 18.65% higher than the JH 33 genotype, which had the lowest chlorophyll b content. Then, the P2/P6 genotype at a dose of 4 ton ha^{-1} recorded the highest chlorophyll b content (157.94 µmol m^{-2}), which was 37.43% higher than the JH 29 genotype, which had the lowest chlorophyll b content.

The interaction between genotype and cattle manure application had a significant effect on total chlorophyll levels and stomatal opening area (Table 7). Quite different results were obtained when compared with observations of chlorophyll a and b. The PAC 225-5-8/Mpop 24 genotype showed the highest total chlorophyll content without manure application (501.16 µmol m^{-2}), which was 23.05% higher compared to the JH 34 (V5) genotype, which had the lowest total chlorophyll content. However, with the application of 2 ton ha^{-1} and 4 ton ha^{-1} of manure, the results showed that the P2/P6 genotypes recorded the highest total chlorophyll levels (488.97 µmol m^{-2} and 501.89 µmol m^{-2}), respectively, which were 11.91% and 25.82% higher, compared to genotype JH 33 at a dose of 2 ton ha^{-1} and JH 29 at a dose of 4 ton ha^{-1}.

When observing the area of stomata opening, the result was that the P2/P6 genotype showed the largest area of stomata opening without manure application (20.41 µm^{2}), which was 73.29% greater than the Nasa 29 genotype, which had the smallest stomata area. When applying 2 ton ha^{-1} of manure, it was found that the MAL 03/P2 genotype showed the largest stomata opening area (33.49 µm^{2}), which was two times greater than the JH 33 genotype, which had the smallest stomata opening area. Then, the JH 33 genotype recorded the largest stomata opening area when applying 4 ton ha^{-1} of manure (59.92 µm^{2}), which was three times greater than the PAC 225-5-8/Mpop 24 genotype, which had the smallest stomata opening area.

Productivity: The interaction between genotype and cattle manure application had a significant influence on corn plant productivity (Table 8). Each application of 0 ton ha^{-1} and 2 ton ha^{-1} of manure showed that the JH 33 genotype

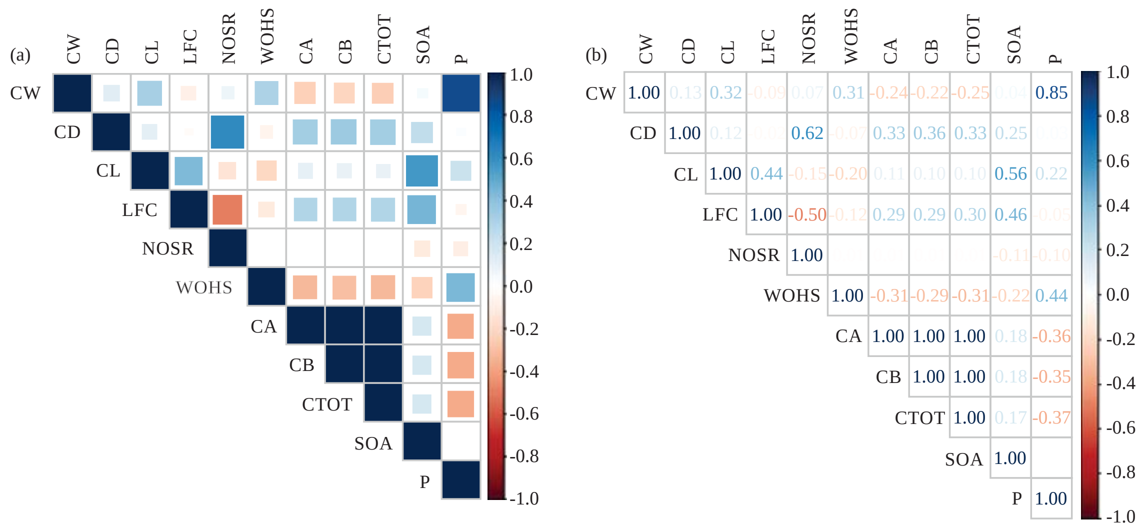

Fig. 1(a-b): Correlation maps among parameters: (a) Correlation based on color, shape and (b) Correlation based on number

CW: Cob weight, CD: Cob diameter, CL: Cob length, LFC: Length filled of cob, NOSR: Number of seed rows, WOHS: Weight of hundred seeds, CA: Chlorophyll a, CB: Chlorophyll b, CTOT: Chlorophyll total, SOA: Stomata opening area and P: Productivity

Table 8. Interaction effect of cattle manure compost and genotypes on productivity

	Productivity (ton ha^{-1})		
Genotype	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}
MAL 03/P2	9.90^{q}	9.32^{q}	9.64^{q}
P2/P6	7.99^{r}	9.91^{pq}	9.20^{q}
JH 29	7.52^{r}	7.02^{r}	12.54^{p}
G102612/P7	10.49^{q}	10.52^{pq}	10.18^{q}
JH 34 (V5)	11.13^{pq}	10.46^{pq}	11.33^{pq}
PAC 225-5-8/Mpop 24	7.53^{r}	7.18^{r}	10.71^{q}
B11209/Avln 864	11.42^{pq}	10.36^{pq}	11.19^{pq}
Nasa 29	9.75^{qr}	9.33^{q}	9.90^{q}
JH 33	12.33^{p}	11.14^{p}	10.10^{q}

Means followed by the same letter are not significantly different for $p \leq 0.05$ according to LSD

recorded the highest productivity (12.33 ton ha^{-1} and 11.14 ton ha^{-1}), which was 63.95% and 58.68% higher than with genotype JH 29 at doses of 0 ton ha^{-1} and 4 ton ha^{-1}. However, the JH 29 genotype recorded the highest productivity when applying 4 ton ha^{-1} of manure (12.54 ton ha^{-1}), 36.30% higher than the P2/P2 genotype, which had the lowest productivity.

Soil chemical properties: Analysis of the chemical characteristics of the soil was also carried out after the research (Table 9). Various soil chemical characteristics change after cattle manure compost application or without application. Soil pH increased by 11.75% from 5.95 (moderately acidic) to 6.65 (neutral) when applying 2 ton ha^{-1} of cattle manure compost. Likewise, levels of C, N, P_2O_5, Ca, Mg, K, Na and CEC tended to increase compared to before the study. This also increased with cattle manure compost application compared to without manure application, except for Mg levels, which were higher without cattle manure compost application.

Correlation among parameters: Correlation (based on color) between observation parameters can be seen in Fig. 1(a-b). Correlation values for these various parameters range from -0.37 to 0.85. Parameters that have a positive correlation with productivity, sorted from the smallest to the largest correlation value, are chlorophyll total (-0.37), chlorophyll a (-0.36), chlorophyll b (-0.35), number of seed rows (-0.10), length of filled cob (-0.05), stomata opening area (0.03), cob diameter (0.03), cob length (0.22), weight of 1000 seeds (0.44) and cob weight (0.85).

Table 9: Soil characteristics after research

Parameter	0 ton ha^{-1}	2 ton ha^{-1}	4 ton ha^{-1}
pH	6.35	6.65	6.59
C	1.77%	1.90%	2.94%
N	0.12%	0.16%	0.21%
C/N	14	12	14
P_2O_5	13.79 ppm	15.85 ppm	16.16 ppm
Ca	4.76 cmol kg^{-1}	7.16 cmol kg^{-1}	7.63 cmol kg^{-1}
Mg	1.04 cmol kg^{-1}	0.61 cmol kg^{-1}	0.58 cmol kg^{-1}
K	0.12 cmol kg^{-1}	0.23 cmol kg^{-1}	0.22 cmol kg^{-1}
Na	0.18 cmol kg^{-1}	0.22 cmol kg^{-1}	0.23 cmol kg^{-1}
CEC	20.38 cmol kg^{-1}	24.22 cmol kg^{-1}	23.26 cmol kg^{-1}

DISCUSSION

Based on the research conducted, the effect of cattle manure compost dose and genotype significantly interacted to influence various observation parameters. Regarding corn cob characteristics, four corn genotypes showed the best performance at each dose of cattle manure compost. The application of 4 ton ha^{-1} of cattle manure compost showed that the JH 29 genotype recorded the highest cob weight, the JH 34 (V5) genotype recorded the widest cob diameter and the JH33 genotype had the most extended cob. There was a tendency for increasing doses of cattle manure compost to improve corn cob characteristics, although the effect varied for each genotype tested. A similar thing was also found by Asmarhansyah[15], who found that cattle manure could increase cob length and cob diameter in corn plants. Apart from that, research conducted by Subaedah *et al.*[16] found a lincob relationship between the dose of cattle manure application and the increase in the cob weight of corn plants.

When observing the length of the filled cob, the JH 33 genotype with the application of 4 ton ha^{-1} of cattle manure compost recorded the most extended length of the filled cob. On the other hand, the JH 29 genotype consistently recorded the highest number of rows of seeds and the heaviest 1000 seed weight on the application of 4 ton ha^{-1} horse manure compost compared to other genotypes. The productivity of corn plants at each dose of cattle manure compost application was only dominated by two genotypes, namely JH 33 and JH 29. The JH 33 genotype recorded the highest productivity at 0 ton ha^{-1} and 2 ton ha^{-1} cattle manure compost application, respectively, while the JH 29 genotype recorded the highest productivity in the application of 4 ton ha^{-1}. Research conducted by Sultana *et al.*[17] found that compost made with additional cattle manure can increase rice production, even increasing the nutritional content of N, P and K in the seeds. Apart from that, this research also reveals that adding compost can significantly reduce the use of inorganic fertilizers. Li *et al.*[18] found that the application of cattle manure compost could increase corn growth and production, even on saline soil, by improving the chemical quality of the soil. Furthermore, the availability of N, P and K can be increased compared to without the application of cattle manure compost. Research conducted by Atman *et al.*[19] also found an increase in rice plant growth and production. At least, adding 1 ton ha^{-1} of cattle manure can increase rice yields by 0.097 ton ha^{-1}.

Observations of chlorophyll a, b and total chlorophyll also found consistent results in the P2/P6 genotype. Genotype P2/P6, with the application of 4 ton ha^{-1} of cattle manure compost, recorded the highest levels of chlorophyll a, b and total chlorophyll compared to other genotypes. However, when observing the area of stomata opening, the application of 4 ton ha^{-1} of cattle manure compost with genotype JH 33 recorded the largest area of stomata opening. Increased plant chlorophyll levels are, of course, influenced by the nutrient content in cattle manure compost, especially N. There is at least 0.55% total nitrogen contained in the horse manure compost used in this research. As previously known, nitrogen plays an essential role in forming plant chlorophyll. Nitrogen is associated with chlorophyll content and determines the yield of plant[20]. High chlorophyll levels certainly impact the rate of assimilate formation for plants.

Based on soil analysis after the research, it was seen that there were changes in the chemical character of the soil after being given cattle manure compost. This is directly related to the chemical content of cattle manure compost itself, which can change the nutrient composition of the soil. Research conducted by Eleduma *et al.*[21] also found changes in the chemical characteristics of the soil when cattle manure was applied to corn plantings. The contents of C, N, P, Na, K and Mg increase with increasing doses given. This change in soil chemical characteristics directly increases corn growth and yield compared to without the application of cattle manure.

Additionally, Tie *et al.*[22] found that low soil pH could be increased with the application of compost. Furthermore, Washa[23] found structural changes in the soil given cattle manure. Organic matter content, porosity and aeration increased on land given cattle manure. The increase in available phosphorus levels were indicated due to the application of cattle manure compost on the research land. The addition of compost can increase the levels of organic matter, which can produce organic acids that can reduce the binding of phosphorus to aluminum and iron so that it can be available to plants[24]. Research conducted by Leaseburg *et al.*[25] found that the addition of cattle manure compost was able to increase C levels and support the N mineralization process in the soil.

From the correlation value, it can be divided into five groups of relationships, namely negligible correlation (0.00-0.10), weak correlation (0.10-0.39), moderate correlation (0.40-0.69), strong correlation (0.70-0.89) and a very strong correlation (0.90-1.00)[26]. In this research, it was found the correlation between productivity and cob weight was classified as strongly correlated. The correlation between grain yield and other traits is a significant factor for the cobly selection of high-yield genotypes because grain yield is influenced by genetic effects and the interaction of genotype and environment[27]. Research conducted by Reddy *et al.*[28] also found a close and positive relationship between yield and corn cob weight. This could mean that increased corn productivity was directly supported by increased plant cob weight. Furthermore, Fadhli *et al.*[29] also confirmed that the weight of harvested cob characteristics and yield traits demonstrated significant correlations with production.

CONCLUSION

Based on the research that has been carried out, it can be concluded that various genotypes to the dose of cow dung compost has different responses in terms of various parameters. However, there is a tendency that as the application dose of cow dung compost increases, the growth and production of corn plants also increased. The highest corn productivity in applying 4 ton ha^{-1} of cattle manure compost was recorded in the JH 29 genotype, 12.54 ton ha^{-1}. In comparison, the JH 33 genotype in the application of 0 ton ha^{-1} of cattle manure compost recorded a productivity of 12.33 ton ha^{-1} so we can obtain both genotypes and identify as the genotype with the highest production compared to other genotypes at various compost application doses. The productivity component is supported directly by cob weight, with a strong correlation value of 0.85. The increase in corn plant productivity is, of course, influenced by the application of cow dung compost, which shows changes in the chemical properties of the soil, with increasing levels of macro and micronutrients in the soil.

SIGNIFICANCE STATEMENT

Increasing corn productivity is currently essential. The use of hybrid corn genotypes and the application of cow manure compost is an alternative for increasing corn production. This study tested nine corn genotypes with three doses of cow manure compost application. From current findings, it was found that various types of corn genotypes had varying responses to various doses of horse manure compost. However, there is a tendency that increasing the application dose linearly increases plant productivity. There are two corn genotypes, namely JH 29 in the application of 4 ton ha^{-1} of compost, namely 12.54 ton ha^{-1} and JH 33 in the application of 0 ton ha^{-1} of compost, namely 12.33 ton ha^{-1}. Therefore, we identified these two corn genotypes with the highest productivity compared to other genotypes at various compost fertilizer doses.

REFERENCES

1. Terán-Chaves, C.A., J.M. Duarte-Carvajalino, C. Ipaz-Cuastumal, A. Vega-Amante and S.M. Polo-Murcia, 2023. Assessing the vulnerability of maize crop productivity to precipitation anomalies: A case study in the semiarid region of Cesar, Colombia. Water, Vol. 15. 10.3390/w15112108.
2. Suhana, S., A. Rauf and Z. Sirajuddin, 2023. Adoption of good agricultural practice (GAp) hybrid corn to increase corn productivity by farmers [In Indonesian]. ZIRAA'AH, 48: 101-114.
3. Purba, R., I. Rosalyne, C.I. Girsang and Y.N. Wilanda, 2022. Growth response of corn (*Zea mays* L.) with dosage treatment of field grass compost (*Axonopus compressus*) and entec fertilizer [In Indonesian]. J. Media Ilmu, 1: 73-87.
4. Kurniawan, P., B. Waluyo and N.R. Ardiarini, 2018. Genetic diversity and yield of eight lines of corn (*Zea mays* L.) S4 generation [In Indonesian]. J. Produksi Tanaman, 6: 1074-1079.
5. Rogers, A.R., J.C. Dunne, C. Romay, M. Bohn and E.S. Buckler *et al.*, 2021. The importance of dominance and genotype-by-environment interactions on grain yield variation in a large-scale public cooperative maize experiment. G3 Genes Genomes Genet., Vol. 11. 10.1093/g3journal/jkaa050.
6. Aristoteles, D., J. Kartahadimaja and dan Eka Erlinda Syuriani, 2019. Potential yield test of six hybrid corn lines assembled by Lampung State polytechnic. J. Planta Symbiosa, 1: 20-30.
7. Liu, L., C. Li, S. Zhu, Y. Xu, H. Li, X. Zheng and R. Shi, 2020. Combined application of organic and inorganic nitrogen fertilizers affects soil prokaryotic communities compositions. Agronomy, Vol. 10. 10.3390/agronomy10010132.

8. Silalahi, Y.H. and dan Anna Satyana Karyawati, 2020. The effect of aplication urea and organic compost fertilizer on growth and yield of sweet corn (*Zea mays saccharata* L.) [In Indonesian]. J. Produksi Tanaman, 8: 345-352.
9. Bunyani, N.A., F. Neolaka, A.W. Finmeta, E.C.G. Kerihi, C.M.A. Manu, M.F. Roman and N.M. Leo, 2023. Increasing farmers' knowledge and skills in making bokashi organic fertilizer at the South Oesapa Marturia Church, Kupang City [In Indonesian]. J. Pengabdian Kepada Masyarakat, 3: 83-91.
10. Wiantoro, K.U., A. Baehaki and Mulyati, 2020. Utilization of cattle waste into compost fertilizer in Duman Village, Lingsar District, West Lombok Regency [In Indonesian]. J. Warta Desa, 2: 62-65.
11. Ren, K., L. Su, Y. Zhang, X. He and H. Wu, 2023. Development and evaluation of cow dung composting equipment with ventilation and heating. Appl. Sci., Vol. 13. 10.3390/app13158649.
12. Mulia, F.I.M., Zaenal Abidin and A.S. Marsanti, 2023. Level of effectiveness of cow manure compost in Jogorogo Village. J. Delima Harapan, 10: 15-21.
13. Guo, L., G. Wu, Y. Li, C. Li and W. Liu *et al*., 2016. Effects of cattle manure compost combined with chemical fertilizer on topsoil organic matter, bulk density and earthworm activity in a wheat-maize rotation system in Eastern China. Soil Tillage Res., 156: 140-147.
14. Hasid, R., A. Bahrun and M.J. Arma, 2021. Residual effect of cow dung fertilizer to corn (*Zea mays* L.) growth and yield in planting period II in marginal land. Asian J. Res. Crop Sci., 6: 44-49.
15. Asmarhansyah, 2016. Improving soil properties and yield of corn (*Zea mays* L.) by application of organic amendment on abandoned tin-mining land in Bangka Island. J. Trop. Soils, 21: 141-151.
16. Subaedah, S., E. Edy and K. Mariana, 2021. Growth, yield, and sugar content of different varieties of sweet corn and harvest time. Int. J. Agron., Vol. 2021. 10.1155/2021/8882140.
17. Sultana, M., M. Jahiruddin, M. Rafiqul Islam, M. Mazibur Rahman, M. Anwarul Abedin and Z.M. Solaiman, 2021. Nutrient enriched municipal solid waste compost increases yield, nutrient content and balance in rice. Sustainability, Vol. 13. 10.3390/su13031047.
18. Li, S., Z. Liu, J. Li, Z. Liu, X. Gu and L. Shi, 2022. Cow manure compost promotes maize growth and ameliorates soil quality in saline-alkali soil: Role of fertilizer addition rate and application depth. Sustainability, Vol. 14. 10.3390/su141610088.
19. Atman, B. Bakrie and R. Indrasti, 2018. Effect of cow manure dosages as organic fertilizer on the productivity of organic rice in West Sumatra, Indonesia. Int. J. Environ. Agric. Biotechnol., 3: 506-511.
20. Wang, N., F. Fu, H. Wang, P. Wang and S. He *et al*., 2021. Effects of irrigation and nitrogen on chlorophyll content, dry matter and nitrogen accumulation in sugar beet (*Beta vulgaris* L.). Sci. Rep., Vol. 11. 10.1038/s41598-021-95792-z.
21. Eleduma, A.F., A.T.B. Aderibigbe and S.O. Obabire, 2020. Effect of cattle manure on the performances of maize (*Zea mays* L) grown in forest-savannah transition zone Southwest Nigeria. Int. J. Agric. Sci. Food Technol., 6: 110-114.
22. Tie, J., Y. Qiao, N. Jin, X. Gao and Y. Liu *et al*., 2023. Yield and rhizosphere soil environment of greenhouse zucchini in response to different planting and breeding waste composts. Microorganisms, Vol. 11. 10.3390/microorganisms11041026.
23. Washa, W.B., 2020. Assessment on potential of cow dung manure in *Zea mays* production at Kiwere Village in Iringa Rural District, Tanzania. Am. J. Plant Sci., 11: 1751-1764.
24. Amini, S. and M.A. Asoodar , 2015. The effect of conservation tillage on crop yield production (The Review). New York Sci. J., 8: 25-29.
25. Leaseburg, E.E., L. Lei and L.S. Fink, 2022. Effects of organic amendments on phenol oxidase, peroxidase, urease, and nitrogen mineralization: A laboratory incubation study. Agrochemicals, 1: 3-16.
26. Schober, P., C. Boer and L.A. Schwarte, 2018. Correlation coefficients: Appropriate use and interpretation. Anesth. Analg., 126: 1763-1768.
27. Djaman, K., C. Owen, M.M. West, S. Allen, K. Koudahe, M. Darapuneni and M. O'Neill, 2020. Relationship between relative maturity and grain yield of maize (*Zea mays* L.) hybrids in Northwest New Mexico for the 2003-2019 period. Agriculture, Vol. 10. 10.3390/agriculture10070290.
28. Reddy, S.G.M., G.M. Lal, T.V. Krishna, Y.V.S. Reddy and N. Sandeep, 2022. Correlation and path coefficient analysis for grain yield components in maize (*Zea mays* L.). Int. J. Plant Soil Sci., 34: 24-36.
29. Fadhli, N., M. Farid, M. Azrai, A. Nur and R. Efendi *et al*., 2023. Morphological parameters, heritability, yield component correlation, and multivariate analysis to determine secondary characters in selecting hybrid maize. Biodiveristas: J. Biol. Diveristy, 24: 3750-3757.