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EVALUATION OF TOLERANCE OF 88 F1 CORN GENOTYPES IN ACIDIC DRY SOIL STRESS IN MONCONGLOE, MAROS BASED ON MORPHOPHYSIOLOGICAL MARKERS

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ABSTRACT

This research was conducted at the Hasanuddin University experimental farm, Moncongloe District, Maros Regency, South Sulawesi with two main objectives: (1) to determine the effect of acidic dry soil stress on genetic diversity and heritability values of agronomic traits of corn plants and (2) to characterize candidate hybrids tolerant to acidic dry soil stress based on the production response of corn genotypes .Method: this study used 88 genotypes with a randomized block design adopted as an experimental design. The parameters in this study were: soil chemical properties, observation of plant characteristics, and analysis of stress tolerance index. Based on the results of this study, it can be concluded that: (1) dry acidic soil stress has an effect on the phenotype and low to moderate values on the heritability of plants with the characters of 10 cob weight, cob length, and productivity having relatively higher values than other characters. (2) Genotypes G62 and G86 occupy the intersection between high yields under optimum conditions (Yp), high yields on acid soils (Ys), and high STI values. Both genotypes are capable of maintaining high yields, namely 8.8–9.0 t ha^{-1} at optimum conditions and 7.5 t ha⁻1 on acid soils. These characteristics reflect the ideal profile in breeding corn tolerant to acid soils.

Key words: Acid, Corn, Genotype, Heritability, Stress

INTRODUCTION

The development of food crops, particularly corn on acidic drylands is still lagging behind due to acidic drylands have limiting factors including low nutrient content, low soil pH, and high aluminum concentrations. The main characteristics of acidic drylands are pH <5.0 with Al saturation >50%. High Al concentrations can inhibit root growth, disrupt water and nutrient absorption by the roots, and then make plants susceptible to drought stress, stunting their growth, and decreasing yields and biomass (Arief, 1987; Rusman 1991). Dry and acidic land in Indonesia has great potential for the development of agricultural cultivation with a total area estimated at 146.46 million hectares, the largest in the order *Ultisol*s and *Inceptisols* spread across the islands of Sumatra, Kalimantan, and Papua (BBSDLP, 2017). The data shows that Indonesia's acidic drylands offer significant potential for corn cultivation.

The use of superior varieties that can adapt or tolerate low pH and nutrient-poor soil conditions is a crucial step in corn cultivation (Azrai *et al*., 2018). However, the number of hybrid corn varieties tolerant to dry, acidic soils is still limited. Hybrid varieties have been shown to have higher yield potential compared to open-pollinated varieties (*inbreeding*) due to the phenomenon of heterosis (Liao *et al*., 2014). Heterosis is an increase in quantitative traits in the F1 generation that is better than both parents (Bourceret *et al*., 2022). Evaluating heterosis in drought- and acid-tolerant maize is important for identifying optimal genetic combinations to increase yields on dry, acidic soils (Tandzi *et al*., 2021).

The first step in developing superior varieties is selecting the right parental lines (Zhang *et al*., 2024). Good parental lines will produce F1 hybrids with superior performance in terms of production and other agronomic traits (Azrai *et al*., 2024). Hybrid varieties are believed to have 15-20% higher production potential than their parents, with early maturity.

Evaluation of corn plant growth and yield can be seen from morphological and physiological characteristics, and the patterns of both characteristics can change depending on environmental influences on the genetics inherited from the parents. The approach taken in this study focused on assessing the growth and yield characteristics of 88 corn genotypes grown on dry, acidic soils. This study aimed to (1) to determine the effect of acidic dry soil stress on genetic diversity and heritability values of agronomic characteristics of corn plants and (2) to characterize candidate hybrids tolerant to acidic dry soil stress based on the production response of 88 genotype filial corn 1.

MATERIALS AND METHODS

This research was conducted at the research installation of the Faculty of Agriculture, Hasanuddin University, Moncongloe experimental farm, Maros Regency, South Sulawesi from September to November 2025. The tools and materials used in this research were 84 hybrid corn seeds (F5xF7-F8xF22) and 4 hybrid seeds with trade-mark names Bisi 18, NK 6172, NK 212, and P50, organic fertilizer, dolomite fertilizer, stakes, paper, plastic labels, treatment boards, herbicides, insecticides, and fungicides.

Preparation of the research land begins with clearing the land of weeds, cultivating the soil, after which it is cultivated. *Plotting* with a size of 2.8 m x 5 m. The distance between replications is 1 m and the distance between plots in the same replication is 70 cm. Each variety is planted on a plot of 1 m x 2 m with two rows per plot then the planting distance between corn plants is 70 cm x 20 cm.

Soil samples were collected prior to conducting the research to analyze the chemical properties of the soil at the research site. The parameters analyzed were pH H_2O, pH KCl, C-organic, N-total, P-available, exchangeable Al^{3+}, exchangeable H^+, potential P, potential K, Ca^{2+}, Mg^{2+}, That$^+$, and K^+.

The experimental design used was a randomized complete block design (RCBD). Treatments consisted of 88 corn variety levels, four replications. The study began by collecting soil samples and measuring soil pH and nutrients in the field to obtain information on acidity and soil parameters before crops planted.

The observation parameters in this study were: 1) Plant height (cm); 2) Height of the cob (cm); 3) Stem diameter (mm); 4) Leaf length (cm); 5) Leaf width; (cm) 6) Leaf chlorophyll; 7) Age of male flowering; 8) Age of female flowering; 9) Weight of 10 cobs (gr); 10) Cob diameter (mm); 11) Cob length (cm); 12) Productivity (t ha^{-1}). Soil samples were collected prior to conducting the research to analyze the chemical properties of the soil at the research site. The parameters analyzed were pH H_2O, pH KCl, C-organic, N-total, P-available, exchangeable Al^{3+}, exchangeable H^+, potential P, potential K, Ca^{2+}, Mg^{2+}, $That^+$, and K^+.

Analysis of genotype that tolerance to soil acidity conditions was carried out to determine resistance genotype to low pH conditions. Tolerance index:

- Stress tolerant index (STI)= (Ys x Yp)/ $\bar{Y}^2p$

Information:
Ys = Observation value of a genotype at low pH conditions
Yp = Observation value of a genotype at normal pH conditions
$\bar{Y}$s = Average observed value of all genotypes at low pH conditions
$\bar{Y}$p = Average observation value of all genotypes under normal pH conditions

The tolerance criteria based on STI are:
STI > 1.0 = Tolerant
0.5<STI<1.0 = median
STI<0.5 = Sensitive

RESULTS AND DISCUSSION

Soil chemical properties

The results of the soil chemical analysis can be seen in (table 1). The value of pH H_2O and pH KCl on site were classified as low with values of 4.58 and 4.16, respectively. The organic C and nitrogen content were moderate with values of 1.84 and 0.28%, respectively. The aluminum and hydrogen are classified as high with values of 3.27 and 4.36 cmol kg^{-1}, respectively. The available P element is in the medium category with a value of 15 ppm. The potential P value is low with a value of 5 mg $100g^{-1}$, while the potential K is moderate with a value of 66 mg $100g^{-1}$. High Ca content, namely 10.04 me $100gr^{-1}$ While the content of Mg = 0.31 me $100gr^{-1}$, K = 0.19 me $100gr^{-1}$, and Na = 0.14 me $100gr^{-1}$, falls into the low category.

Table 1. Soil chemical properties of research location

Parameter	Value	Classification
pH H_2O	4.58	Low
pH KCl	4.16	Low
C-Organic (%)	1.84	Moderate
N-Total (%)	0.28	Moderate
P-Available (ppm)	15	Moderate
Exch. Al (cmol kg^{-1})	3.27	High
Exch. H (cmol kg^{-1})	4.36	High
Potential P (me $100g^{-1}$)	5	Low
Potential K (me $100g^{-1}$)	66	Moderate
Cation exchange capacity: (me $100g^{-1}$)	25.16	-
Ca^{2+}	10.04	High
Mg^{2+}	0.31	Low

K^+	0.19	Low
Na^+	0.14	Low

Vegetative phase

The growth response of several corn genotypes in acidic dryland conditions was relatively lower compared to normal soil conditions. Table 2 presents data on the growth characteristics of corn genotypes grown in acidic dryland conditions.

Table 2. Results of the variety of vegetative characters of genotypes on acidic dry land.

Variables	Mean Square (MS)			
	Block	Genotype	Error	Avg
PH	5802.71	419.90^{ns}	355.96	196.16
HoC	2370.36	183.61^{ns}	157.06	95.86
SD	67.22	3.77^{ns}	3.31	15.90
LL	464.75	50.03^{ns}	50.66	78.67
LW	16.11	1.09^{ns}	1.07	9.22
ClA	1583.38	561.96^{ns}	528.98	353.94
ClB	751.77	185.68^{ns}	173.61	163.37
TotCL	3581.16	1218.59^{ns}	1145.21	511.99

Description: PH = Plant height, HoC = Height of cob, SD = Stem diameter, LL = Leaf length, LW = Leaf width, Cl A = Chlorophyll A, Cl B = Chlorophyll B, TotCL = Total chlorophyll. Ns = not significant at the 0.05 level in ANOVA

No influence is significant at the 0.05 level for the growth characters of corn plant genotypes. The average plant height is 196.16 cm, height of cob 95.86 cm, stem diameter 15.90 mm, leaf length 78.67 cm, leaf width 9.22 cm, chlorophyll A 353.94 *m*mol m^{-2}, chlorophyll B 163.37*m*mol m^{-2}, and total chlorophyll 511.99 *m*mol m^{-2}. The relatively low growth character values compared to corn plants grown on land with normal conditions may occur due to high aluminum levels in the research land which has the potential to inhibit corn plant growth, especially root growth.

The Al content of 3.24 cmol kg^{-1} at the study site is high for plants and can cause toxic conditions for corn. This value is within the range that can inhibit root growth, reduce the surface area for absorption, and then limit the absorption of essential nutrients such as Ca^{2+}, Mg^{2+}, and P (Sopandie, 2025).

Genetic factors play a more dominant role in determining the tolerance and productivity of corn genotypes to dry, acidic soils. This dominance is evident in the yield character (weight of 10 cobs), where the genotype mean square value reached 0.20, significantly higher than the mean square error of 0.15 (Table 3). This finding confirms that yield variation is primarily controlled by genetic factors. A similar pattern was also observed for other yield components. This indicates that the yield potential of a genotype is largely determined by its genetic ability to form and fill kernels under acidic soil conditions.

The dominant influence of genotype is also reflected in physiological traits, particularly leaf chlorophyll content. The genotype mean square values for chlorophyll A, B, and total chlorophyll characters are higher than the mean square error, although statistically it does not provide high significance compared to the error. This indicates a difference in ability between genotypes in maintaining photosynthetic activity even under low pH conditions and aluminum toxicity. These physiological influences contribute directly to the formation of yield components such as weight of 10 cobs, cob length, and productivity. In many studies, yield differences between hybrids on acidic soils are more associated with physiological traits such as chlorophyll content or stay-green character and nutrient use efficiency, as well as yield components such as the number of seeds per row and cob diameter, which are highly controlled by genetic factors (Conscience *et al*., 2020; Zendrato *et al*., 2024b; Mazloom *et al*., 2025).

Generative phase

The production characteristics of corn genotypes grown on acidic dryland soils show varying performance across individuals, similar to plant growth characteristics. However, the weight of 10 cobs character (Table 3) demonstrates a distinct response to genotype variables, which is interesting to study further.

Table 3. Results of the variety of generative characters of genotypes on acidic dry land.

Variables	Mean Square (MS)			
	Block	Genotype	Error	Avg
AMF	192.32	12.88^{ns}	13.50	51.93
AFF	159.16	13.87^{ns}	13.68	53.58
W10C	2.88	0.20*	0.15	1.91
LoC	18.40	4.79^{ns}	3.81	16.12
DoC	104.91	22.16^{ns}	21.28	45.51
Pr	148.21	2.83^{ns}	2.26	5.19

Description: AMF = Age of male flowering, AFF = Age of female flowering, W10C = Weight of 10 cobs, LoC = Length of cob, DoC = Diameter of cob, and Pr = Productivity. * = Significant Ns = Not significant at the 0.05 level in ANOVA

There is influence at the 0.05 level for the weight of 10 cob character with an average value of 1.91 kg or 180 to 200 grams per cob. The average age of male flowering is 51.93 DAP, the age of female flowering is 53.58, the length of the cob is 16.12 cm, the diameter of the cob is 45.51 mm, and the productivity is 5.19 t ha^{-1}. Interesting findings in this study are found in the production character of corn genotypes, especially the parameters of the weight of 10 cobs, cob length, and productivity which are close to "significant effect" at the 0.05 level. Considering that the genotypes are planted in dry acidic land conditions. The relationship between the weight of 10 cobs and cob length is a key factor in determining the productivity of corn plants in land with dry acidic conditions. Considering the chemical properties of dry acidic soils are at low pH, high H content and high Al content which are factors that can limit plant production.

Genotypes that maintain optimal grain filling under these conditions demonstrate better adaptation and high grain yield potential. Fageria *et al*. (2018) confirmed that cob weight and grain weight per plant are key selection indicators in acidic soil environments, a finding further supported by Wang *et al*. (2020) regarding the direct contribution of yield components to maize productivity in low-pH soils.

Zakir (2018) emphasized that yield stability depends on the genotype's ability to respond to environmental conditions. The insignificance of this interaction may reflect consistent performance, but does not guarantee superior adaptation to stressful environments such as acid soils. Therefore, as suggested by Zobel *et al*. (1988), genotype selection should be carried out carefully and consider other agronomic traits beyond the statistical results of the environment × hybrid interaction. This finding emphasizes the need for a comprehensive statistical approach involving multiple traits to fully understand genotype performance across various environmental conditions.

In acidic soils, plant height is related to the root system's ability to explore the soil and absorb nutrients under Al stress and low pH conditions. Cob length and diameter reflect well-developed sink capacity, while the number of kernels per row is closely related to successful pollination and grain filling. Badu-Apraku *et al*. (2017) reported that yield component stability under acid soil stress plays a significant role in maintaining corn grain yield. Furthermore, Li *et al*. (2019) suggested that these yield component traits can be used as indirect selection criteria in corn breeding programs adaptive to acidic drylands. Conversely, phenological and physiological traits showed relatively weak relationships with grain yield under acidic soil conditions. Male flowering days (DAP) and female flowering days (DAP) were not significant on yield, indicating that variation in flowering time is not a major limiting factor for corn productivity in this environment.

Variance components and heritability values

Table 4 shows that the weight of 10 cobs, cob length, and productivity traits have moderate heritability, while the other traits have low heritability. This is consistent with the results from the generative phase (Table 3). This indicates that these traits can be used as benchmarks to assess the next generation.

Table 4. Results of the variance component test and heritability values

Varables	$\sigma^2 g$	$\sigma^2 e$	H^2	Criteria
PH	63.94	355.96	0.15	Low
HoC	26.55	157.06	0.15	Low
SD	0.47	3.31	0.12	Low
LL	0.00	50.66	0.00	Low
LW	0.02	1.07	0.01	Low
ClA	32.99	528.98	0.06	Low
ClB	12.07	173.61	0.07	Low
TotCl	73.38	1145.21	0.06	Low
AMF	0.00	13.50	0.00	Low
AFF	0.19	13.68	0.01	Low
W10C	0.05	0.15	0.25	Moderate
LoC	0.97	3.81	0.20	Moderate

DoC	0.88	21.28	0.04	Low
Pr	0.57	2.26	0.20	Moderate

Description: PH = Plant height, HoC = Height of cob, SD = Stem diameter, LL = Leaf length, LW = Leaf width, Cl A = Chlorophyll A, Cl B = Chlorophyll B, TotCl = Total chlorophyll, AMF = Age of male flowering, AFF = Age of female flowering, W10C = Weight of 10 cobs, LoC = Length of cob, DoC = Diameter of cob, and Pr = Productivity $\sigma^2 g$= Genetic diversity,$\sigma^2 e$= range error, H^2= Heritability.

The primary objective of selection in corn breeding on acid soils is to obtain lines or hybrids capable of stable yields under soil acidity stress, particularly due to aluminum toxicity and limited nutrient availability. Based on the analysis, most traits showed low to moderate heritability values, with H^2 ranging from 0 to 0.25, supported by test populations that have the genetic potential to support selection programs in acid soil environments. Characters such as weight of 10 cobs (H^2= 0.25), Length of cob (H^2= 0.24) and productivity (H^2= 0.2) which is included in the moderate heritability category has the potential to be inherited and is therefore suitable as the main selection criterion in the development of lines or hybrids tolerant to acid soil. The extensive genetic diversity in these traits increases the opportunity to obtain superior adaptive genotypes through repeated selection. This finding is in line with the reports of Bai *et al*. (2016) and Muktamar *et al*. (2018) which state that the effectiveness of selection on acidic soils is greatly influenced by the combination of adequate heritability and extensive genetic variability.

On the other hand, characters with low heritability even though they have wide genetic diversity, such as stem diameter (H^2 = 0.12) or other characters with low H^2 values is less effective as a primary selection criterion in the development of acid soil-tolerant lines. Low heritability values indicate that phenotypic variation of the character is more influenced by the environment than by genetic factors, so that phenotypic selection at a single location or season risks producing unstable lines. In the context of corn breeding for acid soils, these traits are more appropriately utilized in the advanced evaluation stage of genotypes through multi-location trials rather than as the basis for initial line selection. This approach is in line with the principle of selection in environments with high genotype × environment interactions as proposed by Bernardo (2016) and Ceccarelli *et al*. (2019).

Stress sensitivity index (SSI) and stress tolerance index (STI) tests

Table 5. Results of stress sensitivity index (SSI) and stress tolerance index (STI)

Hybrid	Yield (t/ha)		SSI	STI	Hybrid	Yield (t/ha)		SSI	STI
	Yp	Ys				Yp	Ys		
G1	6.35	5.76	0.56	0.81	G45	5.30	3.58	1.96	0.42
G2	5.55	5.33	0.24	0.65	G46	6.68	6.37	0.28	0.94
G3	8.48	6.35	1.52	1.19	G47	4.91	3.79	1.38	0.41
G4	5.15	4.10	1.23	0.47	G48	7.03	6.36	0.58	0.99
G5	5.67	5.24	0.46	0.66	G49	6.92	6.07	0.74	0.93
G6	7.45	5.66	1.45	0.93	G50	7.73	5.86	1.46	1.00
G7	7.72	6.47	0.98	1.10	G51	7.30	6.70	0.50	1.08
G8	6.11	5.25	0.85	0.71	G52	6.22	4.36	1.81	0.60

G9	6.28	5.65	0.61	0.78	G53	5.61	4.80	0.87	0.60
G10	7.47	7.34	0.11	1.21	G54	9.71	6.40	2.06	1.37
G11	6.17	6.13	0.04	0.84	G55	7.69	6.33	1.07	1.08
G12	7.46	6.81	0.53	1.12	G56	7.28	5.13	1.79	0.83
G13	7.20	4.80	2.02	0.76	G57	7.33	6.37	0.79	1.03
G14	7.75	6.58	0.91	1.13	G58	6.47	4.88	1.49	0.70
G15	8.01	5.48	1.91	0.97	G59	5.22	4.98	0.28	0.57
G16	7.25	6.45	0.67	1.03	G60	7.27	6.80	0.39	1.09
G17	6.70	5.66	0.94	0.84	G61	6.30	6.08	0.21	0.85
G18	7.86	6.98	0.68	1.21	G62	8.76	7.45	0.90	1.44
G19	7.88	5.15	2.09	0.90	G63	5.47	5.36	0.12	0.65
G20	4.88	4.35	0.66	0.47	G64	5.99	5.26	0.74	0.70
G21	6.87	6.26	0.54	0.95	G65	6.23	5.14	1.06	0.71
G22	8.44	6.39	1.47	1.19	G66	9.10	6.73	1.57	1.35
G23	7.08	6.67	0.35	1.04	G67	5.41	5.31	0.11	0.63
G24	6.73	6.23	0.45	0.93	G68	3.29	3.19	0.18	0.23
G25	5.66	4.57	1.16	0.57	G69	6.16	5.59	0.56	0.76
G26	6.31	5.14	1.12	0.72	G70	5.26	4.63	0.72	0.54
G27	6.27	5.78	0.47	0.80	G71	8.08	7.77	0.23	1.39
G28	6.49	5.68	0.75	0.81	G72	7.97	7.23	0.56	1.27
G29	6.83	4.45	2.11	0.67	G73	7.35	7.25	0.08	1.18
G30	6.48	3.85	2.45	0.55	G74	7.67	6.83	0.66	1.16
G31	5.71	5.69	0.02	0.72	G75	9.40	5.77	2.34	1.20
G32	5.67	5.51	0.17	0.69	G76	6.51	6.20	0.29	0.89
G33	6.93	5.47	1.27	0.84	G77	6.55	6.12	0.40	0.89
G34	6.10	5.37	0.72	0.72	G78	5.92	4.77	1.17	0.62
G35	6.30	3.45	2.74	0.48	G79	6.35	5.74	0.58	0.81
G36	6.61	4.47	1.96	0.65	G80	5.84	5.20	0.66	0.67
G37	5.67	5.56	0.12	0.70	G81	4.09	3.47	0.92	0.31
G38	5.51	5.06	0.49	0.62	G82	6.90	5.35	1.36	0.82
G39	6.49	5.01	1.38	0.72	G83	6.26	6.12	0.14	0.85
G40	7.63	5.73	1.51	0.97	G84	6.08	4.98	1.09	0.67
G41	6.91	5.02	1.65	0.77	G85	7.02	5.57	1.25	0.86
G42	8.35	5.09	2.36	0.94	G86	9.14	7.62	1.01	1.54
G43	6.37	5.10	1.21	0.72	G87	7.22	6.30	0.77	1.01
G44	7.50	4.67	2.28	0.77	G88	6.71	6.53	0.16	0.97
H45	5.30	3.58	1.96	0.42	Rate-rate	6.72	5.74	0.85	0.88

Description: Ys = Observation value of a genotype at low pH conditions, Yp = Observation value of a genotype under normal pH conditions, SSI = Sensitivity index value, STI = stress tolerance index

An integrative approach combining grain yield under non-stress (Yp) and stress (Ys) conditions with the Stress Tolerance Index (STI) and Stress Sensitivity Index (SSI). The data presented in Table 5 indicate that genotypes G62 and G86 occupy a cross-section between high yield under optimum conditions (Yp), high yield on acid soils (Ys), and high STI values. Both genotypes were able to maintain high yields, namely 8.8–9.0 t ha^{-1} at optimum conditions and 7.5 t ha^{-1} on acid soils. These characteristics reflect the ideal profile in breeding corn tolerant to acid soils, namely the ability to maintain growth and grain filling functions under Al toxicity and nutrient limitation without losing maximum yield potential. Kochian *et al*., (2004) stated that tolerant plants with stable yields under both environmental conditions indicate effective tolerance mechanisms, such as the ability to exclude or detoxify Al in the root system, efficient phosphorus utilization at low pH, and maintenance of photosynthetic activity during the grain filling phase.

Genotypes G62 and G86 occupy the intersection between high yields under optimum conditions (Yp), high yields on acid soils (Ys), and high STI values. Both genotypes are capable of maintaining high yields, namely 8.8–9.0 t ha^{-1} at optimum conditions and 7.5 t ha⁻1 on acid soils. These characteristics reflect the ideal profile in breeding corn tolerant to acid soils, namely the ability to maintain growth and grain filling functions under Al toxicity and nutrient limitation without losing maximum yield potential. Kochian *et al*., (2004) stated that tolerant plants with yield stability under both environmental conditions indicate effective tolerance mechanisms, such as the ability to exclude or detoxify Al in the root system, efficient phosphorus utilization at low pH, and maintenance of photosynthetic activity during the grain filling phase.

In contrast, the G72 hybrid had relatively high STI and yield values on acid soils, but did not outperform under optimum conditions, indicating specific adaptation to acidic environments. With an STI of 1.27 and a yield of 7.23 t ha on acid soils, the G72 genotype showed a higher yield of 7.23 t ha .⁻1, but the optimum yield is only 7.97 t ha⁻1 lower than G62 and G86 this pattern indicates an effective tolerance mechanism in maintaining yield at low pH, but with limited maximum production capacity. Such genotypes are more relevant as donors of tolerance alleles in breeding programs than as commercial varieties for large areas (Tandzi *et al*., (2018); Nginamau *et al*., (2024); Zendrato *et al*., (2024a). This finding emphasizes the importance of comparing sensitive and tolerant hybrids to acid soils to identify genetic mechanisms of adaptation to acid soils and to develop more resilient maize varieties for marginal agricultural environments.

Several other genotypes, such as G50, G51, and G55, exhibited moderate STI values ranging from 1.00 to 1.08, but had significant yield differences between Yp and Ys conditions. These genotypes have good yield potential, but experience a sharp decline in yield under stress conditions. For example, G50 had a Yp of 7.73 t ha⁻1 and Ys is 5.86 t ha⁻1, showed a yield reduction of approximately 24% under stress conditions. This reduction was relatively greater than that of G62 (approximately 15%) and G86 (approximately 17%), reflecting a less stable adaptation strategy.

CONCLUSION

Based on the results of this research, it can be concluded that:

1. dry acid soil stress has an effect on the phenotype and low to moderate values on the heritability of plants with the characters of 10 cob weight, cob length and productivity having relatively higher values than other characters;
2. Genotypes G62 and G86 occupy the intersection between high yields under optimum conditions (Yp), high yields on acid soils (Ys), and high STI values. Both genotypes are capable of maintaining high yields, namely 8.8–9.0 t ha^{-1} at optimum conditions and 7.5 t ha⁻1 on acid soils. These characteristics reflect the ideal profile in breeding corn tolerant to acid soils.

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