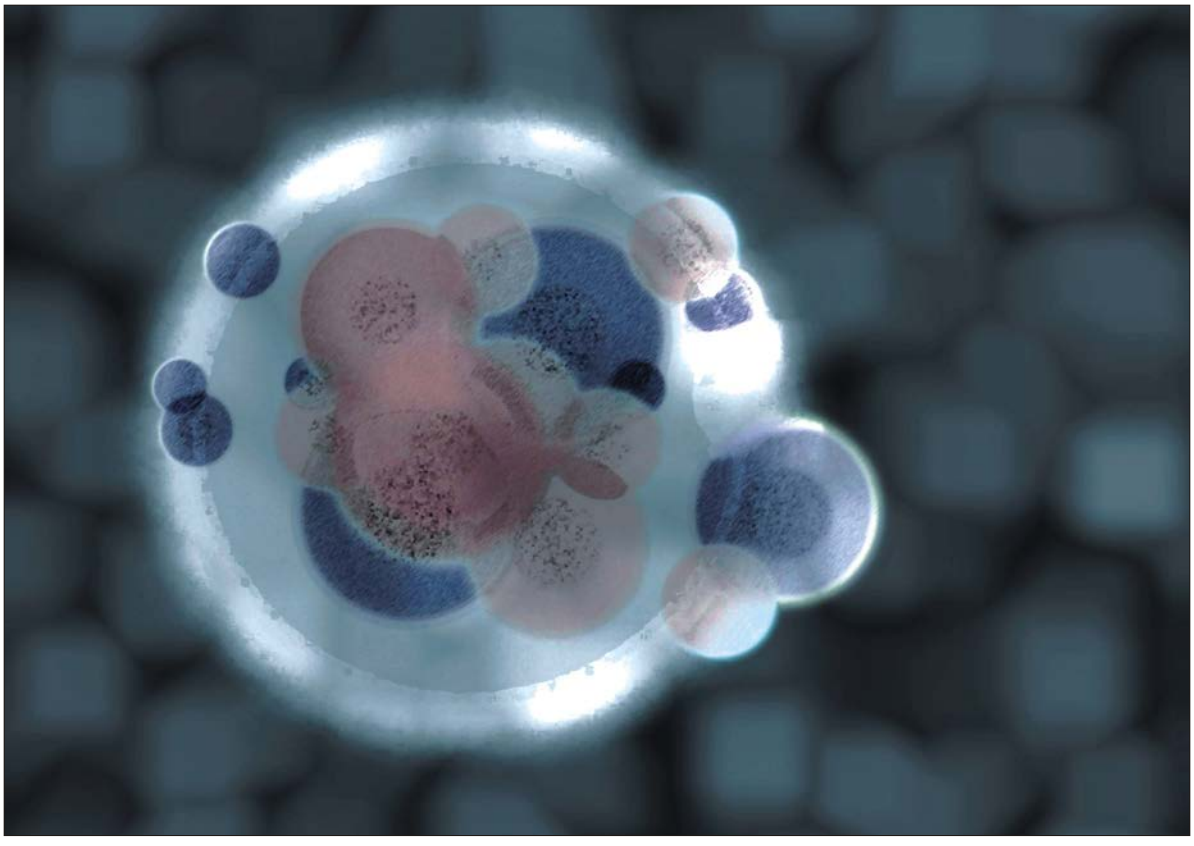

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Evaluation of Agro-nutritional Variations in Quality Protein Maize Accessions

F.A. Showemimo and M.Y. Yeye
Department of Plant Science, Institute for Agricultural Research P.M.B. 1044,
Ahmadu Bello University, Samaru, Zaria

Abstract: Metroglyph and index-score analyses of 10 agro-nutrition characters in 30 quality protein maize lines (accessions) from diverse origin was studied in a Randomized Complete Block Design and replicated thrice in three cropping seasons (1999, 2000 and 2001). Days to physiological maturity and grain yield were used in plotting the glyph (scatter diagram). The 30 QPM lines were separated into six groups. Group I and V; II and IV; III and VI are similar in their days to physiological maturity. Members of Group VI are high yielding, while Group III and IV are potential high yielders with high percent protein content. QPM lines PMG 14 (Group V), PMG 20 and PMG 26 (Group III) PMG 21 (Group I) and PMG 29 (Group VI) are superior lines for crop improvement programs.

Key words: Quality protein maize, agro-nutritional traits, multivariate analysis

INTRODUCTION

Maize is a relatively new entrant crop in the Africans staple food basket; about 26 million tons of maize are produced annually in Africa on approximately 20 million hectares of land, the maize belt in Africa cut across all the agro-ecological zones[1,2]. The persistent problems of hunger and malnutrition in various countries of the continent in which about 35% of the population (approximately 140 million people mostly women and children) suffer from hunger and malnutrition led to the development of Quality Protein Maize (QPM) to reverse the present trend[3,4].

Quality protein maize have been reported to have 10-15% of protein and about twice the tryptophane and lysine level when compared to normal maize QPM has lower ratio of leucine to isoleucine than normal maize[5,6]. The QPM germplasm obtained from different countries has different morphological characters; these characters offer valuable criteria for systematic cataloguing of the available germplasm for crop improvement. Anderson[7]; Kamboj and Mani[8] proposed that the best way to analyze complex morphological variation or diversity is to reduce the measurements of such characters to a sort of pattern, scope or scores, then these scores are compared and grouped accordingly.

Metroglyph analysis had been used in the study of genetic diversity in different crop[9-11]. The present study reports the use of metroglyph analysis in assessing genetic divergence of exotic QPM germplasm with the aim of isolating genotypes with desired agro-nutritional importance for use in crop improvement programs.

MATERIALS AND METHODS

The experimental materials comprised of 30 lines of Quality Protein Maize (QPM). The QPM germplasm from diverse origin were received from Mexico, Zimbabwe, Ghana, Malawi and Uganda. The 30 QPM lines were sown in 1999, 2000 and 2001 cropping seasons at Institute for Agricultural Research (IAR), Samaru, Zaria. The plot size consisted two rows of 5 m long with inter and intra row spacing of 0.8x0.5 m in a Randomized Complete Block Design with three replications. All IAR recommended agronomic practices were followed to raise a successful crop[12]. The QPM lines were evaluated for 10 agro-nutritional characters: days to physiological maturity plant height (cm) ear height (cm) grain yield (t/ha), protein content (%) moisture content (%), carbohydrate (%) ash content (%), fibre content (%) and fat content (%).

Square root data transformation was done for measurements in percent according to Gomez and Gomez[13], analysis of variance was computed according to Steel and Torrie[14]. The data obtained were used to estimate genetic divergence by using metroglyph and index score analysis as proposed by Anderson[7] and later used by Mukherjee *et at.*[15]. Each QPM line was represented as a glyph bearing serial number, all the agro-nutritional characters were represented as rays except days to physiological maturation and grain yield that are

Corresponding Author: Dr. F.A. Showemimo, Department of Plant Science, Institute for Agricultural Research P.M.B. 1044, Ahmadu Bello University, Samaru, Zaria

plotted on a scatter diagram as ordinate and abscissa (Fig. 1).

RESULTS

The minimum days to physiological maturity of QPM line was 90 days while the maximum was 104 days three index score values of 1, 2 and 3 are given to days to physiological maturity (Table 1). Values less than 94.5 scored 1 with a sign of a box without any ray, value from 94.6 to 99.2 scores 2 with a sign of a box having a ray by the left side, values equal or more than 99.3 has a sign of a box with a ray by the right side and scores 3 (Table 1). Generally, the index score of 1 have a sign of a box; index score of 2 have a sign of a box with different position of the ray on the left side; while index score of 3 have a sign of box with different position of the ray on the right side according to the character.

The metroglyph and index score analyses revealed six broad groups in the study material as seen in the scatter diagram (Fig. 1) when days to physiological maturity is plotted against grain yield. The box represents the performance of the 30 QPM lines and position of the rays on the box as regards the characters of study. The QPM lines are clearly grouped into six groups in Table 2. Group I has four QPM lines; PMG 6, 21, 27 and 30, this group is characterized by early days to physiological maturation, medium to tall lines, they are low yielding and the protein content is less than 9.8%. Group II is comprised of four QPM lines; PMG 2, 9, 22 and 23, they have a common characteristic of yielding less than 3 t ha^{-1}, between 1.4 and 1.7% ash content, 2.5 and 3.2% fat with 9.8 and 12.3% protein content and they are medium maturing. Group III also has four QPM lines; (PMG 3, 12, 20 and 26) members of this group have longer days to physiological maturity, tall plants, high ear height, high carbohydrate content, the protein content is between 9.9

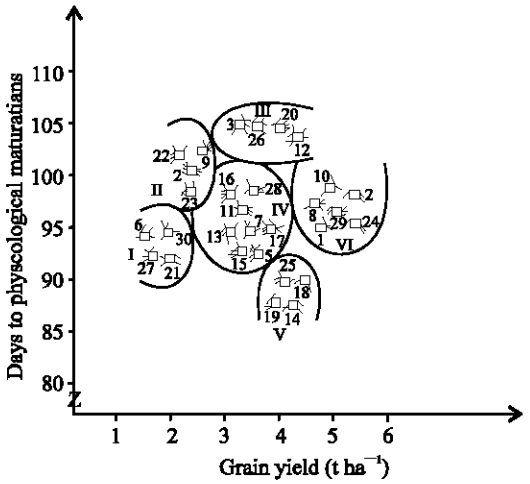

Fig. 1: Scatter diagram of metroglyph analysis of QPM lines

and 12% and they yielded between 3 to 4 t ha^{-1}. There are eight QPM lines (PMG 5, 7, 11, 13, 15, 16, 17 and 28) in group IV and this group has fibre content of 2 to 3%, protein content between 9 to 12% while 95 and 99 days to physiological maturity and they yielded between 3 and 4 t ha^{-1}. The members of Group V include PMG 14, 18, 19 and 25, the group members have moisture content between 6 and 8%, fat content between 2.5 and 3.2% with less than 95 days to physiological maturity, short ear height (≤67.6 cm) and yield between 3 and 4 t ha^{-1}. Group VI has six QPM lines; PMG 1, 4, 8, 10, 24 and 29, the group members are characterized by tall plants (≥187.6 cm), they yielded more than 4 t ha^{-1}, with above 80% carbohydrate content and between 9.9 and 12.3% protein content (Table 1).

DISCUSSION

The metroglyph and index score analyses confirmed the existence of genetic diversity and grouped

Table 1: Traits, range of means and index score obtained in 30 QPM accessions

		Score of 1		Score of 2		Score of 3	
Traits	Range of means	Value less than	Sign	Range	Sign	Value equal or more than	Sign
DPM	90.0-104	94.5	□	94.6-99.2	◪	99.3	◪
PH	147.0-208	167.3	□	167.4-187.5	◪	187.6	◪
EH	57.0-89	67.6	□	67.7-78.3	◪	78.4	◪
GY	2.4-5.1	3.3	□	3.4-4.2	◪	4.3	◪
PRO	7.2-14.9	9.8	□	9.9-12.3	◪	12.4	◪
MOI	4.4-9.6	6.1	□	6.2-7.9	◪	8.0	◪
CHO	72.2-83.2	75.9	□	76.0-79.5	◪	79.6	◪
ASH	0.8-2.2	1.3	□	1.4-1.7	◪	1.8	◪
FIB	1.6-3.7	2.3	□	2.4-3.0	◪	3.1	◪
FAT	1.6-4.0	2.4	□	2.5-3.2	◪	3.3	◪

DPM= Days to physiological maturation; PH= Plant height; EH= Ear height; GY= Grain yield; PRO= Protein; MOI= Moisture; CHO= Carbohydrate; Ash; FIB= Fiber; FAT= Fat, □: Sign of box with out any ray, ◪: Sign of box with ray of left side, ◪: Sign of box with the ray of right side

Table 2: Grouping of 30 quality protein of maize accessions into six groups

Group No.	Accession (Lines)
I	6, 21, 27 and 30
II	2, 9, 22 and 23
III	3, 12, 20 and 26
IV	5, 7, 11, 13, 15, 16, 17 and 28
V	14, 18, 19 and 25
VI	1, 4, 8, 10, 24 and 29

the agro-nutritional distinct QPM lines. Consequently six groups were recognized. In term of days to physiological maturity Group I and V are similar by being early maturing, Group II and IV are also similar (medium maturing), while Group III and VI are late maturing. Group I was distinct with protein content of less than 9.8%, Group II, III and IV are similar, they had protein content of between 9 and 12%. Two QPM lines (PGM 14 and 21) are outstanding in their protein content of more than 12%, though they are in Group V and I, respectively. Members of group VI are outstanding in their yield, they yielded more than 4 t ha^{-1}, Group II members are low yielders. While Group III, IV and V are moderate yielder, similar results had been reported on sunflower[8]; chickpea[10]; wheat[16] and soybean[9]. They were able to use metroglyph and index score analyses to group and select desirable germplasm for crop improvement. Index score indicates the worth of an individual genotype performance[7]. Therefore, this study revealed similar and dissimilar QPM lines based on their performance, thus, QPM lines 14, 20, 21, 26 and 29 were superior in days to physiological maturity, percent protein and grain yield.

Six groups were obtained from 30 QPM line (germplasm) from diverse origin. Members of Group VI were outstanding in term of grain yield though late maturing and tall. Groups III and V have potential of high grain yield with high percent protein. The following QPM lines are superior in their performance as identified by metroglyph and index score analyses: PMG 29 (Group V), PMG 20 and PMG 26 (Group III), PMG 21 (Group I) and PMG 29 (Group VI), these lines will be included in crop improvement programs.

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