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Agronomic Characters, Yield Components and Grain Yield Evaluation of 11 New Hybrid Maize Prospective Genotypes

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***Abstract*— Maize (*Zea mays* L.) is the second important commodity after rice in Indonesia. As of 2015, more than 3 million tons of maize grain still need to be imported. It is caused by productivity of maize which remains low due to the lowness proportion of hybrid maize seed. In addition to a single cross, threeway cross seed is still necessary as alternatives for farmers rather than open pollinated cultivar ones. The purpose of this study was to evaluate grain yield of 11 prospective genotypes utilizing BISI 18 and Sukmaraga as control cultivars. Randomized block design (RBD) with three replications was adopted. The study was carried out in the dry season 2015. The result of this study showed that at 95% confidence level (α=0.05), prospective genotype SSUSX48274 performed significantly better than BISI 18 and Sukmaraga, while others yielded significantly better than Sukmaraga, but equal to BISI 18. All new prospective genotypes could be included in the multilocation trial in order to release superior varieties.**

***Keywords*— Productivity; seed; sukmaraga; *Zea mays* L**

I. INTRODUCTION

Maize (*Zea mays* L.) is the second major commodity after rice in Indonesia. Maize is included in the strategic commodities in agricultural and economic development of Indonesia, due to utilization diversity of this commodity, both for food and feed. In some provinces, maize is consumed as a supplement to the staple food [1]. Diversified applications of maize and its derivatives, have been caused the demand for maize increased over years. In 2014, Indonesia imported 3.25 million metric tons of maize[2], increased to 3.27 million tons in 2015 [3]. In the first quarter of 2016, imports of maize has reached 739 thousands metric tons [4].

Low maize productivity is considered as the main cause of Indonesia's national maize supply shortage. Maize productivity of Indonesia is only 50.7% (Statistic Indonesia, 2015), even 30.6% [5] if compared to the productivity of US maize, which reached 9.76 metric tons per hectare. From 2010 to 2015 the increase of the national maize productivity is only 8.22%. This is equal to 1.64% per year [3]. A sluggish improvement considering Indonesia as agriculture-base country. Base on the above mentioned facts, the productivity of maize in Indonesia must be increased.

The Government of Indonesia represented by the Ministry of Agriculture has been establishing some efforts to improve productivity of maize. This national programs have been established since 2005[6]. But these efforts looked like contributing less to the improvement on both national production and productivity of maize because it only focus on areas which are known as maize production-centers, rather than maize development areas (nonproduction-centers). This is consistent with the results of study of [7], [8], and [9], which stated that the maize productivity in the production-centers were difficult to be increased.

Production development of areas maize are usually constituted of sub-optimal land. These areas generaly have been planted with open pollinated maize varieties which well adapted to the environment but low yielding. Eventualy, these areas contribute to the inferiority of national maize productivity. The utilization level of hybrid maize seed significantly contribute to the productivity of maize. This is in line with the results of the research of [10]-[16], which stated that open pollinated maize productivity is very low.

Data on the proportion of hybrid maize seeds in Indonesia are varies. It shared 7.5% in 1995, rising to 24% in 1999 [10], and gained 28% by 2002 [6]. Meanwhile [1] stated the share of hybrid varieties was 55% in 2010 and increased to 66% in 2012. The statement of [17] admitted that the proportion of hybrid maize in 2014 was only 50%. However all researchers agreed that the proportion or share of hybrid varieties in Indonesia were still very low and needed to be improved. Due to the difficulty to increase the productivity in the production-center areas, the improvement of the proportion of hybrid maize should be focused on the development areas by utilizing appropriate cultivars.

However, productivity improvement in the production-center areas should also be continued.

The purpose of this study was to evaluate the grain yield of 11 new hybrid maize prospective genotypes which consisted of 5 single cross hybrids and 6 three way cross hybrids. The single cross prospective genotypes, were intended to increase the productivity of maize in the production centers, while the three way cross prospective genotypes were intended to improve the productivity of maize in the development areas. As control cultivars, BISI 18 were selected as representation of hybrid cultivars in production centers, while Sukmaraga represented open pollinated cultivars in development areas/non-production centers [18].

II. Material and Methods

Eleven new hybrid maize prospective genotypes which consisted of 5 single cross hybrids and 6 threeway cross hybrids were evaluated for grain yield in this study (Table I). These 11 prospective genotypes were the outcome of the author breeding program which began in 1997. The prospective genotype progenitors were 23 inbred lines which were extracted from landrace populations. These landrace populations were introduced from 7 countries (USA, Mexico, Colombia, India, Thailand, Malaysia, Philippines) and some indigenous landraces of particular areas in Indonesia for their better adaptability. As control cultivars BISI 18 and Sukmaraga were selected. BISI 18 represented hybrid maize cultivars, especially single cross hybrids, while Sukmaraga represented open pollinated maize cultivars [18]. Both cultivars had also been widely accepted by maize farmers in their respective segment in Indonesia. Complete data on the 11 prospective genotypes and 2 control cultivars are presented in Table I.

Randomized block design with 3 replications was adopted in this study. Each plot size of 5 m x 2.8 m, was tillaged with complete soil tillage system which initiated by first plowing, followed by second plowing and harrowing, at 14 days of intervals among process. Every plots consisted of 4 rows. Row spacing was 70 cm, while hole spacing was 20 cm. Prospective genotypes and control cultivars were planted in each plot with 2 seeds per hole. It was expected that there were 200 plants per plot at the time of planting (50 seeds per row by 4 rows). First plant population thinning was conducted at 7 days after the first fertilization (22 days after planting), by removing unwanted plants, especially in holes which consisted 2 plants. It was expected that 120 plants remained per plot after the first plant population thinning (30 plants per row by 4 rows) regardless plant count per hole. Plant count per hole could be either 1 plant or 2 plants, as long as total plants count per plot were 120. The second plant population thinning was conducted at 34 days after planting. Thinning method was similar to the first one. After the second plant population thinning until harvest time, 100 remaining plants had to be maintained in a every plot (25 plants per row by 4 rows) regardless plant count per hole.

Fertilization were applied 2 times during the planting period. The first fertilization was done at 15 days after planting. Urea, SP-36 and KCl were applied at a dose of 250 kg, 100 kg and 50 kg per hectare respectively. Second fertilization was done when the plants were at 35 days after planting, with only 100 kg per hectare of Urea. Dosage of fertilization was adapted from local farmers who had experienced in the cultivation of hybrid maize. Weeding and hilling-up were done 2 times manually (using a hoe). These 2 works was done on the same day with fertilization. The water needed by plants in this study was fully rely on rainfall, without any other artificial irrigation. Harvesting was done by hand. It was done after more than 95% plants had reached physiological maturity and grain moisture content could be measured using a digital grain moisture content tester.

TABLE I
PROSPECTIVE GENOTYPES, THEIR PEDIGREE AND THE CONTROL CULTIVARS

No.	Genotype	Cross	Female Parent		Male Parent	Remark
			Female	Male		
01	SSU3X17782	Threeway cross	SSU3X17782FF	SSU3X17782FM	SSUSX02791M	Prospective genotype
02	SSU3X28871	Threeway cross	SSU3X28871FF	SSU3X28871FM	SSUSX76844M	Prospective genotype
03	SSU3X29131	Threeway cross	SSU3X29131FF	SSU3X29131FM	SSUSX68849M	Prospective genotype
04	SSU3X30735	Threeway cross	SSU3X30735FF	SSU3X30735FM	SSUSX48274M	Prospective genotype
05	SSU3X45172	Threeway cross	SSU3X45172FF	SSU3X45172FM	SSUSX06145M	Prospective genotype
06	SSU3X68276	Threeway cross	SSU3X68276FF	SSU3X68276FM	SSU3X68276M	Prospective genotype
07	SSUSX02791	Single cross	SSUSX02791F		SSUSX02791M	Prospective genotype
08	SSUSX06145	Single cross	SSUSX06145F		SSUSX06145M	Prospective genotype
09	SSUSX48274	Single cross	SSUSX48274F		SSUSX48274M	Prospective genotype
10	SSUSX68849	Single cross	SSUSX68849F		SSUSX68849M	Prospective genotype
11	SSUSX76844	Single cross	SSUSX76844F		SSUSX76844M	Prospective genotype
12	BISI 18	Single cross	-		-	Control cultivar
13	Sukmaraga	Open pollinated	-		-	Control cultivar

Observations of agronomic characters was performed right after the completion of active pollination to plants physiological maturity. Agronomic characters observed in this study were plant height, ear height, anthesis time, silking time, anthesis-silking interval and time to physiological maturity. Anthesis-silking interval was obtained by subtracting the time of silking with the time of anthesis. Observation of yield components and grain yield evaluation were performed after the harvest completed. Yield components observed in this study were ear length, ear diameter, number of rows per ear, number of kernels per row, number of kernels per ear and weight of 1000 kernels. Kernels number per row were obtained by dividing the number of kernels per ear with the number of rows per ear. Agronomic characters and yield components observation were observed on 10 plants which randomly selected at the 2 middle rows in each plot.

Evaluation of grain yield was performed only on plants at the 2 middle rows [19] and [20]. This evaluation included the number of harvested plants per plot, number of harvested ears per plot, harvest ears weight, harvest grain weight and harvest moisture content. Grain yield per hectare at 15% moisture content obtained by the formula:

$$Y = \frac{10000}{HA} \times \frac{100 - MC}{100 - 15} \times HGW$$

Where: Y = grain yield (kg/ha)
HA = harvested area (m2)
MC = harvest moisture content (%)
HGW = harvest grain weight (kg)

This study was carried out in the Village of Kuta Kendit, District of Mardingding, Karo Regency, North Sumatera Province. This study was conducted in the dry season 2015.

III. Result and Discussion

Generally, the germination of research materials were very good (89%-100%) at the beginning. Rainfall with 22 mm intensity 1 day before planting provided favourable moisture for germination of these seeds. However, the rainfall intensity which reached 27 mm at 12 days after planting (V_2) and 43 mm at 14 days after planting (V_3), altered field to be waterlogged and most of the plants in each block completely submerged in water. Fortunately, it did not last too long because of the research field entisols soil high porosity [21]. Plants population thinning from 200 plants per plot to 120 plants per plot (60 plants in the 2 middle rows and 60 plants in the border rows) was performed at 22 days after planting (V_5). At this time, the remaining plant population before being thinned were 76%-93% due to earlier waterlogging stress.

The weather was very good after V_5 phase until the end of the active pollination (R_1). The highest daily temperature during the day was 28^oC and the lowest temperature was 18^oC occurring at night, resulting accumulated growing degree days by 15 points per day. Rainfall intensity between 14 mm-27 mm irrigated the field at 5-8 days intervals. All of this circumstances strongly supported the growth of maize [22]. Pollination and grain filling occurred well from the beginning of silking up to the end of tassel anthesis.

At the beginning of the grain filling phase (R_2) to plants physiological maturity (R_6), daily temperature increased to 30^oC during the day and 21^oC at night, resulting the accumulation of growing degree days by 15.5 points per day. Rainfalls occurred only at 77, 80, and 84 days after planting with the intensity of 16 mm, 12 mm and 11 mm respectively. Further rainfalls were very low (2 mm-4 mm) at intervals of 5-10 days. However, the symptom of physiological stress on drought and heat such as leaf rolling at noon did not occur in all prospective genotypes and control cultivars.

A. Agronomic Characters

Agronomic characters of control cultivars/genotypes in this study (Table II), showed similarity with the agronomic characters descripted in the description of varieties [18]. Anthesis-silking intervals were in the range from 1.2 to 3.8 days and uniform at the 95% confidence level (α=0.05). In accordance with research of [23], [24], [25], [26], [27], [28] and [29], could be ascertained that plants physiological stress did not occur during planting period in this study.

TABLE III
AGRONOMIC CHARACTERS OF THE PROSPECTIVE GENOTYPES AND THE CONTROL CULTIVARS

No.	Genotype	Ear Height (cm)				Plant Height (cm)				50 % Anthesis (days after planting)				50 % Silking (days after planting)				Anthesis-Silking Interval (days)				Physiological Maturity (days after planting)			
		Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average
01	SSU3X17782	121.5	117.1	119.1	119.2	226.7	237.6	285.7	250.0	59.9	60.0	61.0	60.3	62.4	62.3	64.1	62.9	2.5	2.3	3.1	2.6	108.2	108.3	110.1	108.9
02	SSU3X28871	116.8	113.4	129.3	119.8	238.3	213.5	212.1	221.3	59.6	62.4	61.3	61.1	62.1	63.6	63.4	63.0	2.5	1.2	2.1	1.9	108.3	110.4	109.3	109.3
03	SSU3X29131	122.1	127.3	117.6	122.3	225.9	216.6	231.7	224.7	61.1	61.7	60.1	61.0	63.4	64.7	62.5	63.5	2.3	3.0	2.4	2.6	109.4	109.8	108.1	109.1
04	SSU3X30735	122.2	122.6	124.6	123.1	230.2	217.6	218.6	222.1	61.2	61.1	63.5	61.9	63.4	64.1	65.8	64.4	2.2	3.0	2.3	2.5	110.0	108.7	111.2	110.0[a]
05	SSU3X45172	113.5	120.5	113.5	115.8	222.9	209.2	206.2	212.8	62.7	59.0	58.3	60.0	64.9	60.3	60.9	62.0	2.2	1.3	2.6	2.0	110.4	107.8	108.1	108.8
06	SSU3X68276	118.1	105.8	121.6	115.2	238.8	216.4	224.7	226.6	60.8	59.7	59.8	60.1	62.9	63.3	63.0	63.1	2.1	3.6	3.2	3.0	109.2	107.2	107.7	108.0
07	SSUSX02791	123.9	112.3	116.1	117.4	228.3	228.8	234.9	230.7	60.2	59.4	59.7	59.8	62.2	61.1	61.8	61.7	1.7	1.7	2.1	1.8	108.9	108.1	106.8	107.9
08	SSUSX06145	118.3	113.6	116.5	116.1	238.6	210.9	235.5	228.3	61.1	60.8	61.5	61.1	63.8	62.9	62.8	63.2	2.7	2.1	1.3	2.0	110.7	109.6	109.6	110.0[a]
09	SSUSX48274	123.8	120.6	124.9	123.1	224.7	233.1	231.0	229.6	61.0	61.6	62.9	61.8	63.3	63.9	65.2	64.1	2.3	2.3	2.3	2.3	108.6	108.4	110.4	109.1
10	SSUSX68849	123.0	113.7	117.5	118.1	237.5	231.9	229.1	232.8	61.4	62.5	61.1	61.7	63.6	66.4	64.5	64.8	2.2	3.8	3.4	3.1	111.2	113.3	111.7	112.1[ab]
11	SSUSX76844	118.8	121.2	118.6	119.5	242.9	216.8	214.3	224.7	61.3	60.4	62.4	61.4	63.5	62.1	65.3	63.6	2.2	1.7	2.9	2.3	110.4	108.8	110.6	110.0[a]
12	BISI 18	122.6	117.7	116.7	119.0	237.5	238.4	235.6	237.2	61.2	62.5	61.2	61.6	64.3	64.2	63.8	64.1	3.1	1.7	2.6	2.5	109.1	106.9	107.4	107.8
13	Sukmaraga	121.8	128.9	130.3	127.0	208.1	234.7	233.6	225.5	61.1	60.1	59.5	60.2	62.3	61.8	61.4	61.8	1.2	1.7	1.9	1.6	109.6	109.2	108.5	109.1
	Average	120.5	118.1	120.5	119.7	230.8	223.5	230.2	228.2	61.0	60.9	60.9	60.9	63.2	63.1	63.4	63.3	2.2	2.3	2.5	2.3	109.5	109.0	109.2	109.2

Remark: a = significantly higher than Sukaraga, b = significantly higher than BISI 18. Confident level = 95% (a=0.05).

Analysis of variance showed that at confident level of 95% (α=0.05) there were no variance among genotypes regarding agronomic characters of ear height, plant height, anthesis, and anthesis-silking interval. P values ranged from 0.0613 to 0.2464. At the same confident level, the variation among genotypes occured only in agronomic character of physiological maturity, where 1 prospective genotype SSUSX68849 showed significantly longer physiological maturity compared to the both control cultivars, while prospective genotypes SSU3X30375, SSUSX06145 and SSUSX76844 showed significantly longer physiological maturity compared to BISI 18 only. The other prospective genotypes performed similar physiological maturity compared to both control cultivars.

In all aspects of agronomic characters, there were no variance between blocks/replications for all prospective genotypes and both control cultivars. At the 95% confidence level (α=0.05) P values ranged from 0.3228 to 0.9667. Therefore, it could be ensured the uniformity of agronomic characters on the entire prospective genotypes at confident level of 95% (α=0.05). Uniformity of agronomic characters is one of the conditions of prospective genotypes to be released as superior hybrid varieties [20].

B. Yield Components and Grain Yield

Analysis of variance at confident level 95% (α=0.05) showed significant variance among all aspects of yield components (Table III). The entire P value were lower than 0.05 (P value<0.05), with value of F ranged between 4.3374 to 242.0763, higher than $F_{critical}$ 2.1834. This result were similar with [30].

Prospective genotypes SSU3X45172, SSUSX06145, SSUSX68849 and SSUSX76844 significantly produced longest ears at confident level 95% (α=0.05) compared the both control cultivars. Prospective genotypes SSU3X17782, SSU3X28871, SSU3X29131 and SSU3X68276 produced same length ears with BISI 18 but significantly longer than Sukmaraga. Prospective genotypes SSU3X30735, SSUSX02791 and SSUSX48274 produced similar ear length only with Sukmaraga.

At the same confident level, prospective genotypes SSU3X17782, SSU3X28871 and SSU3X68276 significantly produced bigger ears diameter than both control cultivars. Another prospective genotypes except SSUSX02791, performed similar ear diameter if compared to BISI 18 but significantly bigger if compared to Sukmaraga. Meanwhile, all of prospective genotypes were significantly lower in number of row per ear compared to BISI 18 although still found to be equal to Sukmaraga.

Regarding number of kernels per ear and number of kernels per row, 4 prospective genotypes which were SSUSX02791, SSUSX06145, SSUSX68849 and SSUSX76844 found to be significantly more superior than both control cultivars. The others performed equal to BISI 18 while remained significantly better than Sukmaraga. There were no prospective genotypes which performed more superior compared to BISI 18 (all prospective genotypes equal to BISI 18) in terms of weight 1000 kernels at 15% moisture content, but 2 prospective genotypes which were SSU3X28871 and SSU3X68276 showed higher 1000 kernels weight compared to Sukmaraga.

All genotypes showed no variance among genotype's number of plants at harvest, number of ears at harvest, harvest moisture content and grain recovery (Table IV). Meanwhile, variances found to be significant in the aspects of harvest ear weight, harvest grain weight and grain yield at 15% moisture content. There were 8 prospective genotypes which signicantly better than Sukmaraga but only equal to BISI 18 in the aspect of harvest ear weight, while 3 prospective genotypes which were SSU3X17782, SSU3X28871 and SSU3X45172 performed only equal to Sukmaraga. In the aspects of harvest grain weight and grain yield at 15% moisture content (showed in Fig. 1), prospective genotype SSUSX48274 showed significantly better than both control cultivars. Another prospective genotypes performed significantly better than Sukmaraga but equal to BISI 18.

TABLE III
YIELD COMPONENTS OF THE PROSPECTIVE GENOTYPES AND THE CONTROL CULTIVARS

No.	Genotype	Ear Length (cm)				Ear Diameter (cm)				Number of Row Per Ear				Number of Kernel Per Row				Weight 1000 Kernel at 15% Moisture Content (g)			
		Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average
01	SSU3X17782	17.7	17.5	17.7	17.7 [a]	5.1	5.6	5.5	5.4 [ab]	14.4	14.6	15.0	14.7 [ac]	33.7	32.9	31.5	32.7 [a]	300.0	310.0	324.0	311.3
02	SSU3X28871	16.1	18.5	18.0	17.5 [a]	4.9	5.5	5.4	5.3 [ab]	15.6	15.4	15.4	15.5 [ac]	30.3	30.7	30.2	30.4 [a]	327.0	326.0	332.0	328.3 [a]
03	SSU3X29131	15.7	18.3	18.1	17.4 [a]	4.6	5.4	5.4	5.1 [a]	15.6	15.4	15.6	15.5 [ac]	29.8	30.3	29.4	29.8 [a]	326.0	331.0	293.0	316.7
04	SSU3X30735	16.0	15.8	15.5	15.8	5.0	4.9	4.9	4.9 [a]	15.6	15.2	15.2	15.3 [ac]	31.5	31.9	31.4	31.6 [a]	330.0	307.0	317.0	318.0
05	SSU3X45172	18.7	18.6	18.9	18.7 [ab]	4.8	4.7	4.8	4.8 [a]	14.0	14.0	14.0	14.0 [ac]	35.9	35.0	35.6	35.5 [a]	294.0	292.0	318.0	301.3
06	SSU3X68276	16.0	17.8	17.7	17.2 [a]	4.9	5.6	5.5	5.4 [ab]	15.6	15.6	15.8	15.7 [ac]	30.9	31.0	30.0	30.6 [a]	351.0	356.0	347.0	351.3 [a]
07	SSUSX02791	16.0	15.9	15.5	15.8	4.3	4.4	4.3	4.3	14.4	14.4	14.4	14.4 [ac]	36.3	37.8	37.1	37.1 [ab]	329.0	334.0	303.0	322.0
08	SSUSX06145	19.5	19.3	19.2	19.3 [ab]	5.0	5.0	4.9	5.0 [a]	14.2	14.2	14.4	14.3 [ac]	38.1	37.6	36.7	37.5 [ab]	327.0	335.0	309.0	323.7
09	SSUSX48274	15.6	15.8	15.9	15.8	5.0	5.0	4.9	5.0 [a]	16.0	15.8	15.8	15.9 [ac]	32.0	32.0	31.6	31.9 [a]	304.0	305.0	316.0	308.3
10	SSUSX68849	20.0	19.8	19.9	19.9 [ab]	4.9	4.8	4.7	4.8 [a]	15.2	14.8	14.8	14.9 [ac]	44.4	45.3	44.6	44.8 [ab]	311.0	324.0	322.0	319.0
11	SSUSX76844	19.9	19.7	19.3	19.6 [ab]	5.2	5.1	5.0	5.1 [a]	15.6	15.2	15.2	15.3 [ac]	39.0	39.6	38.8	39.2 [ab]	329.0	296.0	316.0	313.7
12	BISI 18	15.7	15.5	18.5	16.6 [a]	4.9	4.8	4.8	4.8 [a]	16.6	16.8	16.8	16.7 [a]	31.6	31.0	30.4	31.0 [a]	361.0	341.0	347.0	349.7 [a]
13	Sukmaraga	15.0	14.8	14.7	14.8	4.2	4.2	4.1	4.2	12.4	12.6	12.6	12.5	33.7	32.9	32.3	32.9	317.0	291.0	303.0	303.7
	Average	17.1	17.5	17.6	17.4	4.8	5.0	4.9	4.9	15.0	14.9	15.0	15.0	34.3	34.4	33.7	34.1	323.5	319.1	319.0	320.5

Remark: a = significantly higher than Sukaraga, b = significantly higher than BISI 18, c = significantly lower than BISI 18. Confident level = 95% (α=0.05).

TABLE IIIV

GRAIN YIELD OF THE PROSPECTIVE GENOTYPES AND THE CONTROL CULTIVARS

No.	Genotype	Number of Plants at Harvest				Number of Ears at Harvest				Harvest Moisture Content (%)				Harvest Ear Weight (kg)			
		Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average
01	SSU3X17782	50.0	50.0	50.0	50.0	53.0	54.0	61.0	56.0	32.2	31.2	32.2	31.9	12.0	10.6	8.8	10.5
02	SSU3X28871	50.0	50.0	50.0	50.0	53.0	61.0	70.0	61.3	29.2	31.6	30.9	30.6	12.0	11.6	9.7	11.1
03	SSU3X29131	50.0	50.0	50.0	50.0	63.0	60.0	64.0	62.3	29.9	31.2	31.6	30.9	13.0	12.3	11.4	12.2 [a]
04	SSU3X30735	50.0	50.0	50.0	50.0	58.0	54.0	50.0	54.0	32.0	32.3	32.0	32.1	12.0	13.7	11.8	12.5 [a]
05	SSU3X45172	50.0	50.0	50.0	50.0	57.0	56.0	55.0	56.0	32.1	28.5	29.4	30.0	12.3	10.1	12.3	11.6
06	SSU3X68276	50.0	50.0	50.0	50.0	68.0	64.0	56.0	62.7	32.5	32.7	30.2	31.8	14.8	13.1	12.3	13.4 [a]
07	SSUSX02791	50.0	50.0	50.0	50.0	65.0	62.0	60.0	62.3	30.3	31.9	30.9	31.0	12.0	12.5	16.3	13.6 [a]
08	SSUSX06145	50.0	50.0	50.0	50.0	53.0	60.0	65.0	59.3	30.9	30.6	30.5	30.7	14.8	13.5	15.3	14.5 [a]
09	SSUSX48274	50.0	50.0	50.0	50.0	59.0	61.0	57.0	59.0	30.2	29.4	31.5	30.4	16.3	14.3	13.8	14.8 [a]
10	SSUSX68849	50.0	50.0	50.0	50.0	55.0	52.0	50.0	52.3	30.6	32.6	30.4	31.2	13.4	18.2	13.6	15.1 [a]
11	SSUSX76844	50.0	50.0	50.0	50.0	54.0	55.0	51.0	53.3	31.0	30.0	31.4	30.8	12.8	14.9	10.0	12.6 [a]
12	BISI 18	50.0	50.0	50.0	50.0	59.0	59.0	52.0	56.7	30.1	31.5	29.3	30.3	15.2	10.4	12.0	12.5 [a]
13	Sukmaraga	50.0	50.0	50.0	50.0	56.0	59.0	56.0	57.0	30.3	28.1	29.1	29.2	12.6	8.1	6.8	9.2
	Average	50.0	50.0	50.0	50.0	57.9	58.2	57.5	57.9	30.9	31.0	30.5	30.8	13.3	12.6	11.9	12.6

No.	Genotype	Harvest Grain Weight (kg)				Recovery (%)				Grain Yield at 15% Moisture Content (kg/ha)			
		Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average	Rep-1	Rep-2	Rep-3	Average
01	SSU3X17782	10.3	7.4	7.9	8.5 [a]	85.8	69.8	89.8	81.8	11,737	8,557	9,002	9,765 [a]
02	SSU3X28871	9.6	8.5	7.3	8.5 [a]	80.0	73.3	75.3	76.2	11,423	9,771	8,478	9,891 [a]
03	SSU3X29131	9.7	10.3	8.9	9.6 [a]	74.6	83.7	78.1	78.8	11,428	11,910	10,231	11,190 [a]
04	SSU3X30735	9.8	10.0	8.7	9.5 [a]	81.7	73.0	73.7	76.1	11,200	11,378	9,943	10,840 [a]
05	SSU3X45172	9.7	8.5	10.1	9.4 [a]	78.9	84.2	82.1	81.7	11,069	10,214	11,984	11,089 [a]
06	SSU3X68276	10.6	9.7	9.1	9.8 [a]	71.6	74.0	74.0	73.2	12,025	10,972	10,675	11,224 [a]
07	SSUSX02791	10.1	8.9	11.9	10.3 [a]	84.2	71.2	73.0	76.1	11,831	10,186	13,820	11,946 [a]
08	SSUSX06145	11.6	9.8	12.1	11.2 [a]	78.4	72.6	79.1	76.7	13,472	11,431	14,134	13,012 [a]
09	SSUSX48274	13.1	11.5	12.2	12.3 [ab]	80.4	80.4	88.4	83.1	15,368	13,645	14,045	14,353 [ab]
10	SSUSX68849	9.1	12.9	10.8	10.9 [a]	67.9	70.9	79.4	72.7	10,614	14,613	12,633	12,620 [a]
11	SSUSX76844	9.3	11.7	8.6	9.9 [a]	72.7	78.5	86.0	79.1	10,785	13,765	9,915	11,488 [a]
12	BISI 18	11.9	8.2	9.9	10.0 [a]	78.3	78.8	82.5	79.9	13,980	9,440	11,764	11,728 [a]
13	Sukmaraga	4.7	6.2	5.4	5.4	37.3	76.5	79.4	64.4	5,506	7,492	6,435	6,477
	Average	10.0	9.5	9.5	9.6	74.7	75.9	80.1	76.9	11,572	11,029	11,005	11,202

Remark: a = significantly higher than Sukaraga, b = significantly higher than BISI 18. Confident level = 95% (α=0.05).

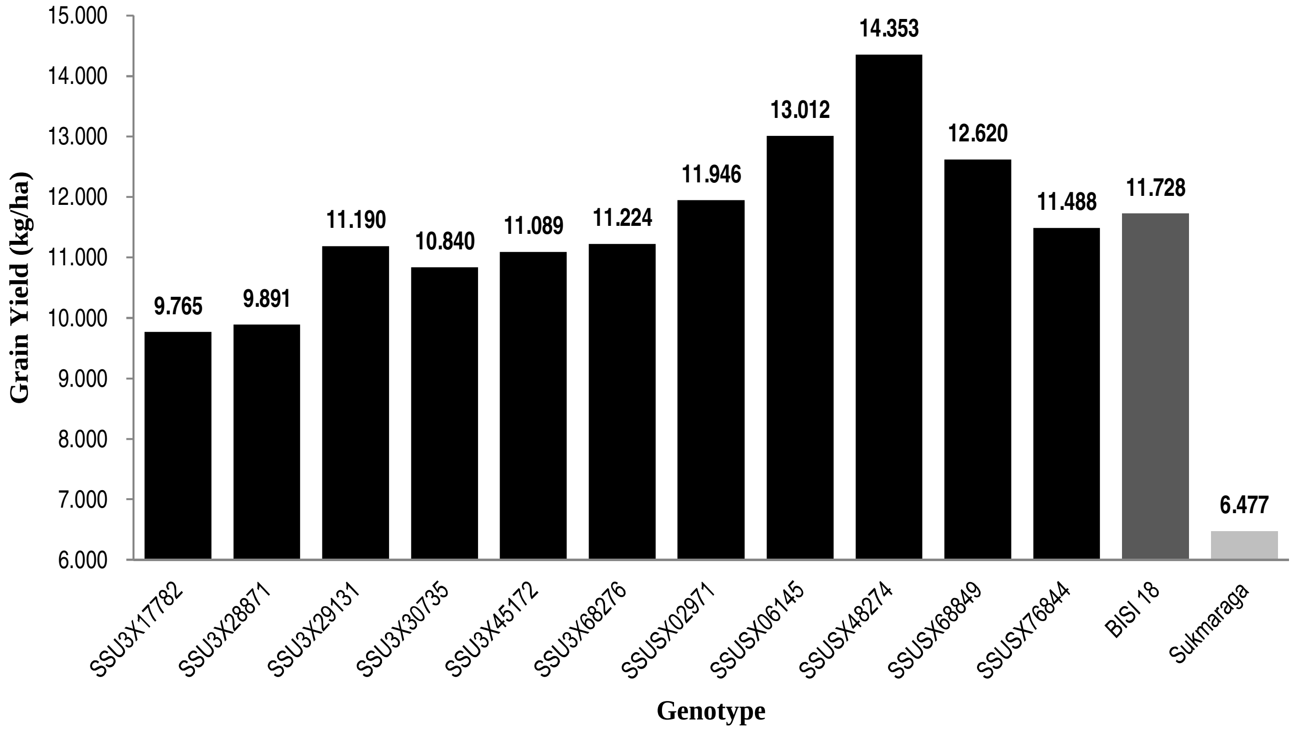

Fig. 1 Chart of Grain Yield at 15% Moisture Content

Pearson coefficient of correlation (r) analysis showed that 1 agronomic character and 5 yield components which were anthesis-silking interval (r=0.437), ear diameter (r=0.528), number of rows per ear (r=0.529), harvest ear weight (r=0.833), harvest grain weight (r=0.995) and weight of 1000 kernel at 15% moisture content (r=0.535), significantly had possitive correlation to grain yield at 15% moisture content at 95% confident level (α=0.05). Meanwhile Spearman's coefficient of correlation (ρ) analysis showed that no agronomic character and only 4 yield components which significantly had possitive correlation to grain yield at 15% moisture content at the same confident level. These yield components were ear diameter (ρ=0.439), number of rows per ear (ρ=0.829), harvest ear weight (ρ=0.988) and harvest grain weight (ρ=0.553). These results were inline with [31], [32], [33], [34] and [35].

All of prospective genotypes expressed no variance among replication in all aspect of yield components except at number of kernels per row (P value=0.0006). Uniformity in the number of kernels per row probably caused by 27 mm of rainfall 67 days after planting, when some genotypes already at the last phase of active pollination resulting poor grain filling. P value ranged among 0.1239 to 0.9124, all higher than 0.05. Therefore, genotype uniformity as one of superior hybrid maize release requirements [20] could be fulfilled.

IV. Conclusions

Prospective genotype SSUSX48234 was found to be significantly better than BISI 18 and Sukmaraga in grain yield at 15% moisture content. Another prospective genotypes performed significantly better than Sukmaraga dan showed equal performance compared to BISI 18. Therefore, all of prospective genotypes could be proceeded to multilocation trial in order to release superior hybrid maize cultivars.

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