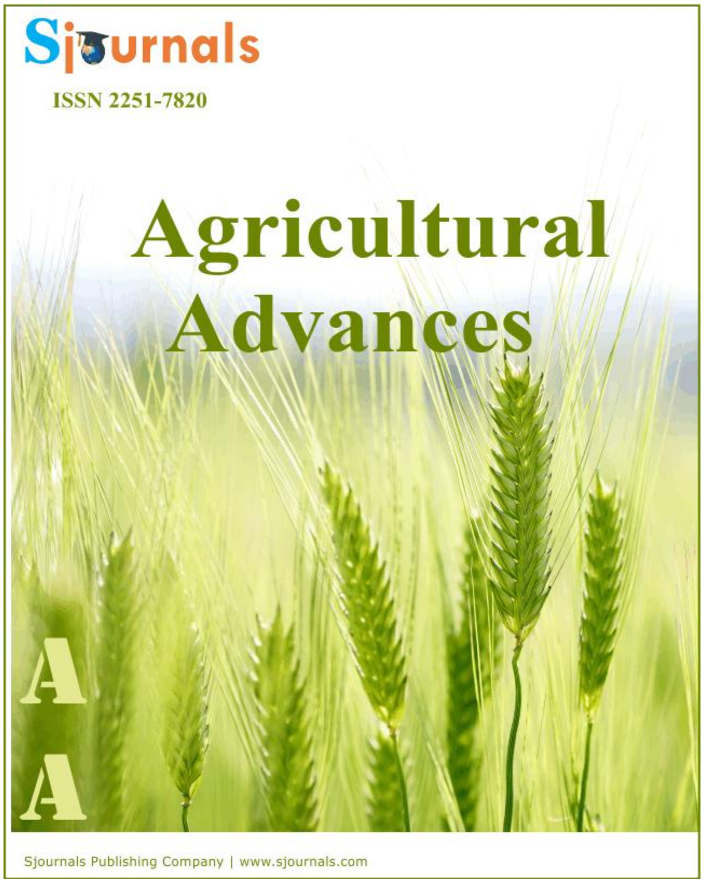
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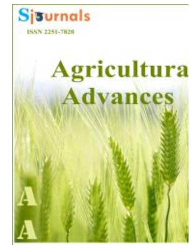

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Original article

Investigation and comparison of sweet corn hybrids yield after rice harvesting

M.H. Haddadi*, M. Mohseni

Scientific member of Agronomy and Horticulture Crops research Department, Mazandran, Agricultural and Natural Resources research Center, AREEO, Sari, Iran.

*Corresponding author; Scientific member of Agronomy and Horticulture Crops research Department, Mazandran, Agricultural and Natural Resources research Center, AREEO,Sari, Iran.

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In order to investigation and compare of kernel and other traits of eight sweet corn hybrids with conventional sweet corn (SC403) an expriment was conducted in randomized compelet block design at the Agricultural and Natural Resources Research Center of Mazandran, Qarakheil, Qaemshahr, Iran in 2007-2009 (three years) after rice harvesting (August). Each hybrid was planted in four rows. Each row included 30 plants at 20 cm distance from each others. Harvesting was done in two middle rows. After harvesting, kernel yield for each hybrid determined. analysis of variance and mean comparison were done. The result in three years showed that higher kernel yields were resulted from hybrids BASIN and POWER HOUSE with 7.66 and 7.31 t/ha respectively. these hybrids had higher yield than the check (SC403) with 6.11 t/ha and there was significant difference at 5%level between check and these hybrids according to Duncan's Multiple Range Test. EX08716636 Had higher kernel yield than the check (SC403) but this hybrid had not significant difference at 5% level. Hybrids CHALLENGER with 5.34 t/ha, HARVEST GOLD with 5.16 t/h, OBSSESION with 5.01 t/h, CHASE with 4/26 t/h and TEMPTATION with 3.8 t/h had lower kernel yields than check. HARVEST GOLD, POWER HOUSE and BASIN had Higher forage yeild with 50.99, 50.58 and 48.71 t/ha respectively but these hybrids had not significant difference at 5%level in compare of SC403 with 49.29 t/ha forage yield. Correlation between measuremented traits was showed that kernel yield have positive correlation with forage yield (%76), kernel row number (%60), kernel in row (%56) and ear diameter (%66). Kernel yield had negative correlation with cob diameter (-%56). Forage yield also had positive correlation with plant height (%67), ear hight(%81), kernel row number (%55), kernel in row (%54) and ear diameter (%70). Forage yield had negative correlation with cob diameter (-%55).

1. Introduction

Sweet corn (Zea mays convar. saccharata var. rugosaalso called sugar corn, dent corn and pole corn) is a variety of maize with a high sugar content. Sweet corn is the result of a naturally occurring recessive mutation in the genes which control conversion of sugar to starch inside the endosperm of the corn kernel. Unlike field corn varieties, which are harvested when the kernels are dry and mature (dent stage), sweet corn is picked when immature (milk stage) and prepared and eaten as a vegetable, rather than a grain. Since the process of maturation involves converting sugar to starch, sweet corn stores poorly and must be eatenfresh, canned,or frozen, before the kernels become tough and starchy (Erwin, 1951). Hybridization allowed for more uniform maturity, improved quality and disease resistance. In most of Latin America, sweet corn is traditionally eaten with beans; each plant is deficient in an essential amino acid that happens to be abundant in the other, so together sweet corn and bean form a protein-complete meal. In Brazil, sweet corn cut off from the cobs is generally eaten with peas (where this combination, given the practicality of steamed canned grains in an urban diet, is a frequent addition to diverse meals such as salads, stews, seasoned white rice, risottos, soups, pasta, and, most famously, whole sausage hot dogs) (Kaloo et al., 1993). Similarly, sweet corn in Indonesia is traditionally ground or soaked with milk, which makes available the B vitamin niacin in the corn, the absence of which would otherwise lead to pellagra; in Brazil, a combination of ground sweet corn and milk is also the basis of various well-known dishes, such as pamonha and the pudding-like dessert curau, while sweet corn eaten directly off the cobs tends to be served with butter.

The kernels are boiled or steamed. In Europe, China, Korea, Japan and India, they are often used as a pizza topping, or in salads. Corn on the cob is a sweet corn cob that has been boiled, steamed, or grilled whole; the kernels are then eaten directly off the cob or cut off. Creamed corn is sweet corn served in a milk or cream sauce. Sweet corn can also be eaten as baby corn（Kaloo et al., 1993). If left to dry on the plant, kernels may be taken off the cob and cooked in oil where, unlike popcorn, they expand to about double the original kernel size and are often called corn nuts. A soup may also be made from the plant, called sweet corn soup. Kernel may also was dried (Stickler and Laude 1960; Williams et al., 1988). Cooked sweet corn increases levels of ferulic acid, which has anti-cancer properties. Open pollinated (non-hybrid) corn has largely been replaced in the commercial market by sweeter, earlier hybrids, which also have the advantage of maintaining their sweet flavor longer. Su cultivars are best when cooked within 30 minutes of harvest. Despite their short storage life, many open pollinated cultivars such as 'Golden Bantam' remain popular for home gardeners and specialty markets, or are marketed as heirloom seeds. Although less sweet, they are often described as more tender and flavorful than hybrids. Early cultivars, including those used by Native Americans, were the result of the mutant su ("sugary") allele. They contain about 5–10% sugar by weight (Kavkis et al., 1986).

All of the alleles responsible for sweet corn are recessive, so it must be isolated from other corn, such as field corn and popcorn, that release pollen at the same time; the endosperm develops from genes from both parents, and heterozygous kernels will be tough and starchy. The se and su alleles do not need to be isolated from each other. However supersweet cultivars containing the sh2 allele must be grown in isolation from other cultivars to avoid cross-pollination and resulting starchiness, either in space (various sources quote minimum quarantine distances from 100 to 400 feet or 30 to 120 m) or in time (i.e., the supersweet corn does not pollinate at the same time as other corn in nearby fields). Modern breeding methods have also introduced cultivars incorporating multiple gene types:sy (for synergistic) adds the sh2 gene to some kernels (usually 25%) on the same cob as a se base (either homozygous or heterozygous) augmented sh2 adds the se and su gene to a sh2 parent. Often seed producers of the sy and augmented sh2 types will use brand names or trademarks to distinguish these cultivars instead of mentioning the genetics behind them. Generally these brands or trademarks will offer a choice of white, bi-color and yellow cultivars which otherwise have very similar characteristics (Kavkis et al., 1986). Selecting high-yield cultivars adaptive to regional climate, is important factor in achieving the maximum efficiency in sweet corn production. Realizing the highest possible yield depends upon adequate moisture availability, soil fertility and crop genetic capacities (Hashemi-Dezfuli et al., 2001). Sweet corn is sensitive in flowering stage to water stress(Chotena et al.,1980). Sweet corn breeding, has created the new types of sweet corn with good quality food storage capacity (Hallauer, 1993). The spread of sweet corn likely begun from Peru to Mexico, in the south - west of the United States and then begun to spread in the northern parts (Boyer et al., 1984; Kaloo et al., 1993). Hybrid cultivars increased sweet corn yield (Meghji, 1984). Sweet corn as soon as possible cultivation, it will be better performance (Martin and Lindquist, 2007).

Breeding and preparation of different sweet corn cultivars, sweet corn performance and the quality of the sweet corn improved (Olaoye et al., 2009; Alan et al., 2007).

Sweet corn (*Zea mays* L.), considered a vegetable, is a special type of corn with particular characteristics, such as sweet taste, thin pericarp and endosperm with delicate texture, and a high nutritional value (Kwiatkowski and Clemente, 2007).

The difference between sweet and common corn is that in the genome of the former, at least one of the eight genes that influence carbohydrate biosynthesis in the endosperm is mutant, preventing the conversion of carbohydrate to starch (Tracy et al., 2006; Qi et al., 2009).

Among various types of corn, sweet corn has the greatest potential for use as human food. Sweet corn is originated through mutation and it is characterized by having at least one of the eight mutant genes. The main genes are: *Shrunken*-2 (sh2) on chromosome 3, *Brittle* (bt) and *Amylose Extender* (ae) on chromosome 5, Sugary Enhancer (if), Sugary (su) and “Brittle-2” (BT2) on chromosome 4; “Dull” (du) on chromosome 10, and Waxy(wx) on chromosome 9 (Tracy et al., 2006). In Iran sweet corn was used as forage for animal and feeding for human.

2. Materials and methods

In order to compare of kernel and other traits of eight sweet corn hybrids with conventional sweet corn (SC403) an expriment was conducted in randomized compelet block design at the Agricultural and Natural Resources Research Center of Mazandran, Qarakheil, Qaemshahr, Iran (31°28' N, 52°35' E) in 2007-2009 (three years). Eight cultivars named CHASE, CHALLENGER, BASIN, HARVEST GOLD, TEMPTATION, OBSESSION, EX08716636 and POWER HOUSE were planted after rice harvesting (1th, August)and compared with check(SC403).

Each hybrid was planted in four rows. Each row included 30 plants at 20 cm distance from each others.Harvesting was done in two middle rows. After harvesting, kernel yield, plant height, ear height, cob diameter, forage yield, kernel row number, kernel number in row and ear diameter for each hybrid determined. analysis of variance and mean comparison were done. Data were analyzed using the by MSTAT-C procedure to develop the ANOVA for a randomized compelet block design. The DMRT procedure was used to make tests of treatment effects by MSTAT-C, all differences reported are significant at $P < 0.05$ unless otherwise stated.

3. Results and discussin

Results of combinend analysis variance (3 years) showed that there was significant difference on cultivar effects on sweet corn kernel yield and forage (Table 1). Means comparison showed that the highest kernel yield is in related with BASIN with 7.66 t/ha that had not significant difference with POWER HOUSE cultivar with 7.31 t/ha kernel yield. EX08716636 with 6.31 t/ha and SC 403 with 6.11t/ha had less kernel yield than BASIN and POWER HOUSE cultivars. Cultivars of CHALLENGER (5.34 t.ha), HARVEST GOLD (5.16 t.ha), OBSESSION (5.01t/ha) and CHASE(4.26t/ha) had lower kernel yield respectivly. TEMPTATION cultivar with 3.8t/ha had the least kernel yield (Table 2). HARVEST GOLD, POWER HOUSE and BASIN had Higher forage yeild with 50.99 , 50.58 and 48.71 t/ha respectively but these hybrids had not significant difference at 5% level in compare of SC403 with 49.29 t/ha forage yield. Cultivars of OBSESSION with 44.61, EX08716636 with 43.33 t/ha, CHALLENGER with 37.01 t/ha, TEMPTATION with 28.52 t.ha and CHASE with 28.9 t/ha had lower kernel yield respectivly (Table 2). HARVEST GOLD had highest plant height with 154.1 cm, lowest plant height was in related to CHASE with 101 cm. The highest and lowest ear height is related to HARVEST GOLD with 58.6 cm and TEMPTATION with 34.2 respectively. HARVEST GOLD and POWER HOUSE had highest number row in ear with 20 and 18 row respectively. The highest and lowest seed in row is related to BASIN with 42 and CHALLANGER with 32 number respectively. The lowest cob diameter is in related to SC403 with 3.51 cm and BASIN with 3.54 cm. EX08716636 had the highest cob diameter with 3.96cm. The highest ear diameter is related to HARVEST GOLD and CHASE with 4.79 and 4.78cm. According to result, it is better we plant POWER HOUSE or BASIN for kernel or forage usage after rice planting in August. SC403 cultivar also is suitable cultivar for forage at this condition.

Correlation betweet measuremented traits was showed that kernel yield have positive correlation with forage yield (%76), kernel row number (%60), kernel in row (%56) and ear diameter(%66). Kernel yield had negative correlation with cob diameter (-%56). Forage yield also had positive correlation with plant height(%67), ear hight (%81), kernel row number (%55), kernel in row (%54)and ear diameter(%70). Forage yield had negative correlation with cob diameter (-%55).

Plant height had positive correlation with ear height(%75) and kernel row number(%84). Kernel row number had positive correlation with ear cob diameter (%81)and ear diameter (%55).Kernel number in row had positive correlation with cob diameter (%69). Cob diameter had positive correlation with ear diameter(%76).

Table 1

Analyze of variation of the data related to the kernel and forage yield.

Source of variation	DF	Kernel yield (Ton/ha)	Forage yield (Ton/ha)
Year(Y)	2	87.35**	3708.8 **
Error	9	1.89	65.27
Cultivar(A)	8	20.28**	956.68 **
Y x A	16	4.18**	83.59 **
Error	72	0.73	24.44
C.V%		15.1	11.7

*,** and ns significant at the 5% , 1% and non significant respectively.

Table 2

Means comperison of kernel and forage yield.

Cultivars	Kernel yield (Ton/ha)	Forage yield (Ton/ha)
CHASE	4.26d	28.90d
CHALLENGER	5.34c	37.01c
BASIN	7.66a	48.71a
HARVEST GOLD	5.16c	50.99a
POWER HOUSE	7.31a	50.58a
TEMP TATION	3.8d	28.52d
OBSESSION	5.01c	44.61b
EX08716636	6.31b	43.33b
SC403	6.11b	49.29a

Different letters in each colum shows significant difference at %5 probability (DMRT).

Table 3

Means of some measuremented traits.

Cultivars	PH(cm)	EH(cm)	Row	Seed in row	Cob diameter(cm)	Ear diameter(cm)
CHASE	101	36	14	42	3.64	4.78
CHALLENGER	104.1	39.2	16	32	3.62	4.69
BASIN	106.5	48.4	14	42	3.54	4.58
HARVEST GOLD	154.1	58.6	20	39	3.68	4.79
POWER HOUSE	150.4	46.2	18	38	3.67	4.71
TEMP TATION	112.3	34.2	16	27	3.46	4.45
OBSESSION	108.9	38.7	16	33	3.55	4.61
EX08716636	120.4	42.8	16	33	3.96	4.73
SC403	139.6	60.2	16	33	3.51	4.43

PH: Plant height, EH: Ear height, Row: Kernel row number in ear, KROW:Kernel number in ear row ,CD: Cob diameter, ED: Ear diameter.

Table 4

Correlation between the measuremented traits

Traits	KY	FY	PH	EH	ROW	KROW	CD	ED
KY	1	0.76**	0.32ns	0.47ns	0.60*	0.56 *	-0.56*	0.66*
FY	0.96**	1	0.67*	0.81**	0.55*	0.54*	-0.55*	0.70*
PH			1	0.75**	0.84**	0.10ns	0.32ns	0.42ns
EH				1	0.49*	0.29ns	0.49ns	0.05ns
ROW					1	0.15 ns	0.81**	0.55*
KROW						1	0.29 ns	0.32ns
CD							1	0.76*

KY: Kernel yield, FY: Forage yield, PH: Plant height, EH: Ear height, Row: Kernel row number in ear, KROW: Kernel number in ear row, CD:Cob diameter, ED: Ear diameter. ns,* and **: Non significant, significant at 5% and 1% levels, respectively.

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