

PERFORMANCE OF SOME FEED AND SWEET CORN VARIETIES IN THE EASTERN PROVINCE OF SAUDI ARABIA

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Summary

The performance of five corn cultivars including two hybrid feed corn, two hybrid sweet corn and one pureline sweet corn was observed in the spring growing season on an old cultivated soil in the Al-Hassa Oasis of Eastern Saudi Arabia. Intense heat, strong sunlight and low humidity prevailing in the middle of May caused slight injury to the newly emerged tassels and young leaves of Hawaiian Sugar but not to the other varieties. The optimum number of days to tasselling in Al-Hassa appeared to be in the range of 60 to 63 days from sowing. Leaf area indices of 3.5 to 4.1 and 4.8 to 4.9 might be adequate for achieving high yields for sweet corn and feed corn cultivars respectively.

Hawaiian Sugar significantly outyielded other varieties in fresh stalks. In general, sweet corn produced fresh stalks of better quality than those of feed corn. Golden Cross Bantam gave a higher yield of fresh ears than the other two sweet corn varieties but the differences failed to reach a significant level. It appears, therefore, that Golden Cross Bantam is the most suitable variety of those tested for growing as a vegetable in the Al-Hassa Oasis. The dry grain yields of Tainan 5 and Tainan 11 both exceeded 8 tons per ha, showing that these two hybrid feed corn cultivars from Taiwan have great potential in the area.

Introduction

The growing of corn (*Zea mays* L.) in the Al-Hassa Oasis, the leading agricultural area in the Eastern Province of Saudi Arabia, is still an uncommon practice. Only five tones of sweet corn were produced as vegetables in 1973 (Labban, 1974) but no feed corn production has been recorded so far. However, in view of the recent interest in developing the poultry industry in Saudi Arabia, corn growing may assume greater importance in the future. Corn flour is the major ingredient of poultry feed, constituting nearly 60 per cent of the feeding materials. Growing corn may also have particular appeal to farmers in Al-Hassa, because it could be grown in rotation with the traditional summer rice crop, the corn crop being taken in spring when more water is available for irrigation. Investigations recently conducted by the Chinese Rice Mission indicate that corn is highly adaptable to the growing conditions in Al-Hassa (CRM Report III, 1974; CRM Report IV, 1974).

In recognition of the potential importance of corn in this area, the Chinese Rice Mission has conducted a series of experiments to identify cultivars most adaptable to the local environment. This paper summarizes the results of the 1975 spring crop.

Materials and Methods

Five corn varieties, two feed corn and three sweet corn, were grown from March to June at Holeila village, Al-Hassa, on an old, saline, sandy loam soil which had been in cultivation for many years. The two feed corn varieties were Tainan 5 and Tainan 11, both hybrids developed by the Corn Research Centre in Taiwan. The three sweet corn varieties included one pureline variety, Hawaiian Sugar and two hybrids, Golden Cross Bantam and Golden Beauty 66, all coming from the United States.

The experiment was arranged in a randomized complete block design with four replications. Each plot consisted of three rows each five metres long with a row to row spacing of 60 cm. The four-metre section of the inner row was used for the measurement of stalk and grain yields. Sowing date was 15 March 1975. Corn seeds were sown by hand at a spacing of 20 cm within a row. The plots received 150 kg of N and 100 kg of P_2O_5 per ha. One-third of the N and all of the P_2O_5 were applied as a basal dressing at the time of sowing while the balance of N was top-dressed in equal amounts at four weeks after sowing and at the tasselling stage. Good weed control was achieved by hand weeding. The experimental field was irrigated once every 7 to 10 days when there was no rainfall. Other management practices were kept at the optimum levels. Varieties were harvested as they reached appropriate maturity stages. Sweet corn varieties were thus harvested approximately two weeks earlier than feed corn varieties.

Data were recorded for number of days to tasselling, number of days to maturity, leaf area index (LAI), diameter of the internode, plant height, ear length, weight per ear, shelling percentage, yields of fresh stalk, ear and dry grain. The area of an individual leaf was computed as the product of its length and greatest width multiplied by 0.75. The data for fresh stalk, fresh ear and dry grain yields were all subjected to the analyses of variance.

Results and Discussion

Climate

The climatic data for the spring 1975 corn growing season are given in Table 1. Temperature was low during the initial stages of corn growth but it rose rapidly from the beginning of May and remained high afterwards. The increase in temperature was accompanied by an increase in solar radiation and a decrease in relative humidity (Table 1). The high temperature, intense sunlight and low humidity in the middle of May (when most of the varieties were at the tasselling stage) caused slight injury to the newly emerged tassels and leaves of the variety Hawaiian Sugar. Symptom of sunburn developed and the new growth eventually became desiccated. Other varieties were undamaged however, which suggests that corn varieties differ in their abilities to withstand the intense

heat and strong sunlight. Golden Beauty 66 may have escaped injury because it tasselled in late April when temperature and solar radiation had not risen to the levels occurring in May. It appears desirable, therefore, that corn varieties less sensitive to sunburn should be selected for spring sowing in the Al-Hassa Oasis. In addition, the sowing date should be brought forward to late February or early March so that the tasselling of most intermediate maturing varieties occurs in late April before temperature and solar radiation become too high.

Table 1. Climatic data, Al-Hassa Oasis, Spring crop, 1975

Month	Temperature (°C)			Relative humidity (%)	Radiation cal/cm ² /d
	Max.	Min.	Mean		
March	27.4	12.0	19.7	41.7	479
April	32.3	16.7	24.5	45.6	502
May	39.4	21.8	31.4	33.6	530
June	41.9	24.7	34.8	26.4	609

Growth Characteristics

Corn varieties varied considerably in the number of days they took to reach the tasselling and the maturity stages (Table 2). Golden Beauty 66 took only 44 days to tassel while the other four varieties tasselled 60 to 63 days after sowing. Sweet corn varieties matured 26 to 28 days after tasselling while feed corn took 39 to 40 days to reach maturity. Since sweet corn is used primarily as a vegetable, it has to be harvested when the ear is still soft and tender. The earliest maturing variety Golden Beauty 66 gave the lowest yield of fresh ear (Table 3), suggesting that a period of 44 days to reach the tasselling stage was not long enough for optimum production. The optimum number of days to tasselling for the spring crop of corn in Al-Hassa may be in the range of 60 to 63 days.

Leaf area index measured at the tasselling stage ranged from 1.59 for Golden Beauty 66 to 4.87 for Tainan 11, the latter being three times larger than the former. The leaf area index for the others was 3.50 for Golden Cross Bantam, 4.14 for Hawaiian Sugar and 4.80 for Tainan 5 (Table 2). The lowest leaf area index, associated with Golden Beauty 66, may also be responsible for the low yield it produced (Table 3). Thus, a leaf area index of 3.5 to 4.1 for sweet corn and 4.8 to 4.9 for feed corn appears necessary for optimum yields in the Al-Hassa spring crop of corn. Hunter *et al.* (1970) reported that maximum grain yields of corn were associated with a leaf area index of 3.3 to 4. Baynes (1972) also reported that the best grain yields from the improved tropical hybrid corn varieties were associated with a leaf area index of about 4.

Feed corn varieties generally grew taller than sweet corn varieties. Tainan 11 was the tallest with average plant height of 230.6 cm whereas Golden Beauty 66 was the shortest,

having an average height of only 128.1 cm (Table 2). The stalk diameter ranged from 1.60 cm for Golden Beauty 66 to 2.22 cm for Hawaiian Sugar (Table 2). The others were 2.03 cm for Tainan 5, 2.07 cm for Golden Cross Bantam and 2.11 cm for Tainan 11. The short plants of Golden Beauty 66 with small stalk size may also be related to the low yield it produced. No lodging of plants was observed even though the plant height of some cultivars was greater than two metres.

Table 2. Some agronomic traits of corn, spring crop, 1975

Variety	Days to tasselling	Days to maturity	Leaf area index	Plant height (cm)	Stalk diameter (cm)
Tainan 5	61.0	99.5	4.80	215.8	2.08
Tainan 11	63.3	102.8	4.87	230.6	2.11
Hawaiian Sugar	62.8	89.5	4.14	210.9	2.22
Golden Cross Bantam	59.8	85.5	3.50	182.6	2.07
Golden Beauty 66	44.3	72.5	1.59	128.1	1.60

Yield Performance

The mean length and weight per ear, shelling percentage and yields of fresh stalks, fresh ears and dry grains are presented in Table 3. It can be seen that Golden Beauty 66 and Hawaiian Sugar produced the shortest ears with average lengths of 15.3 and 15.5 cm respectively. Golden Cross Bantam and Tainan 11 gave medium long ears of 17.8 and 18.5 cm respectively. The ear length of 19.5 cm for Tainan 5 was the longest among the varieties tested. In general, the ears of feed corn were longer than those of sweet corn.

Fresh weight per ear of feed corn was generally larger than that of sweet corn varieties (Table 3). Among varieties of either feed or sweet corn, however, fresh weight per ear varied slightly. The mean fresh weight per ear of Tainan 5 was 182 gm and that of Tainan 11, 185 gm. Sweet corn varieties Hawaiian Sugar, Golden Cross Bantam and Golden Beauty 66 gave fresh weights of 130, 147 and 135 gm per ear respectively.

Dry weight per ear of feed corn was three times greater than that of sweet corn (Table 3). Again there were slight differences in dry weight per ear among varieties for each group of corn. Tainan 5 produced the heaviest ear of 101 gm while Golden Beauty 66, the lightest ear of 25 gm. The dry weight per ear of feed corn varieties was between 51 and 56 per cent of the fresh weight, whereas for sweet corn varieties dry weight per ear ranged from 19 to 26 per cent only of the weight of fresh ears.

Feed corn gave higher shelling percentage than sweet corn varieties (Table 3). The shelling percentage of 90.2 for Tainan 5 was the highest, followed by 85.9 per cent for Tainan 11. Hawaiian Sugar ranked third with 72.2 per cent, while Golden Cross Bantam and Golden Beauty 66 gave 67.6 and 67.4 per cent respectively, which were the lowest outturn of grain to cob among the varieties tested.

Hawaiian Sugar, a pureline cultivar of sweet corn, produced the highest yield of fresh stalks with 31.79 tons per ha, while Golden Beauty 66 gave the lowest with only 12.48 tons per ha of fresh stalks. The yields of fresh stalks for the other varieties were 26.25 tons per ha for Tainan 11, 23.44 tons per ha for Golden Cross Bantam and 21.73 tons per ha for Tainan 5. Differences in the yield of fresh stalks were significant at the 1 per cent level of probability. Fresh corn stalks are suitable for either direct feeding to cattle or sheep or for making silage. The leaves and stems of sweet corn appeared fresh and green at the time of harvesting while those of feed corn were already partly drying, indicating that the feeding quality of sweet corn stalks was better than that of feed corn stalks. The pattern of varietal difference for the yield of fresh stalks appeared similar to that of stalk diameter (Table 2), indicating that stalk diameter is an important trait contributing to the yield of fresh stalks of corn.

The yield of fresh ear did not differ significantly within varieties of either group but the varietal differences between groups of corn were all significant (Table 3). The fresh ear yield of 15.49 tons per ha for Tainan 11 was the highest whereas Golden Beauty 66 gave the lowest yield of 11.25 tons per ha. The yield ratio of fresh ear to fresh stalk ranged from 1 : 1.1 for Golden Beauty 66 to as large as 1 : 2.8 for Hawaiian Sugar. Fresh ear production is of greater significance in sweet corn since it is usually marketed as such. Among the three sweet corn varieties, Golden Cross Bantam produced the highest yield of fresh ears (12.55 ton/ha) followed by Hawaiian Sugar (11.31 ton/ha) while Golden Beauty 66 yielded the lowest. The ear length and fresh weight per ear appeared to be the most important factors affecting the yield of fresh ears (Table 3). In an unreplicated trial conducted in the autumn crop of 1974, the yield pattern was also the same with Golden Cross Bantam giving the highest yield of 10.39 tons per ha (CRM Biannual Report, 1975). The results clearly demonstrate that the sweet corn variety Golden Cross Bantam appears highly adaptable to Al-Hassa conditions. Labban (1974) also reported that Golden Cross Bantam has proved to be one of the most suitable varieties for Eastern Saudi Arabia. The average yield of sweet corn in the area has been estimated to be 12.49 tons per ha in the autumn crop while that of the spring crop is about 9.8 tons per ha (Labban, 1974).

Feed corn produced much greater yields of dry grain than sweet corn varieties, the differences being highly significant (Table 3). The highest grain yield (8.61 ton/ha) was given by Tainan 5 which was nearly three times higher than that of the highest yielding sweet corn variety Hawaiian Sugar (2.92 ton/ha). Tainan 11 ranked second with 8.24 tons per ha of dry grains. The 2.06 ton/ha produced by Golden Beauty 66 was the lowest. Differences in grain yield between the two feed corn varieties as well as between the three sweet corn varieties failed to reach a significant level, however. In the unreplicated trial conducted in the autumn crop of 1974, Tainan 11 yielded 5.8 tons per ha (CRM Biannual Report, 1975). Higher grain yields were closely associated with heavier dry ear weight and higher shelling percentage (Table 3).

The dry grain yields produced in this experiment for Tainan 5 and Tainan 11 exceeded yields obtained in Taiwan which varied from 5 to 7 and 5 to 8 tons per ha for Tainan

5 and Tainan 11 respectively (Wang, 1974). The grain yield of 8.61 ton/ha produced by Tainan 5 even surpassed the highest recorded yield of 8.2 ton/ha produced by a farmer in Taiwan (Cheng, 1972). This indicates that both hybrid feed corn cultivars introduced from Taiwan possess high yield potential and are well adapted to the Al-Hassa area. The high solar energy prevalent in the area may be one of the factors contributing to the high yields of these two feed corn varieties in the Al-Hassa Oasis.

In this experiment, plant population was fixed at 83,333 plants per ha for all cultivars. These cultivars differed greatly in some growth characteristics (Table 2) and it seems unlikely that this fixed plant density indicates the full yield potential of individual cultivars, since the optimum population usually varies with plant size. For cultivars with shorter plants such as Golden Beauty 66, an increase in yield may be possible through an increase in plant density which directly influences leaf area index and grain yield (Baynes, 1972). On the contrary, populations of taller varieties such as Tainan 11 can be slightly reduced to provide better ventilation and light penetration. In Taiwan, plant population of 57,000 plants per ha is recommended for Tainan 11 (Wang, 1974).

Table 3. Yields and components of yield, spring crop, 1975

Variety	Ear length (cm)	Weight/ear		Shelling percentage (%)	Yield (ton/ha) *		
		Fresh (g)	Dry (g)		Fresh stalk	Fresh ear	Dry grain
Tainan 5	19.5	182	101	90.2	21.73 c	15.34 a	8.61 a
Tainan 11	18.5	185	96	85.9	26.25 b	15.49 a	8.24 a
Hawaiian Sugar	15.5	130	34	72.7	31.79 a	11.31 b	2.92 b
Golden Cross Bantam	17.8	147	34	67.6	23.44 bc	12.55 b	2.83 b
Golden Beauty 66	15.3	135	25	67.4	12.48 d	11.25 b	2.06 b
C. V. (%)	—	—	—	—	11.15	10.69	21.03

* For each yield, any two means with a common letter are not significantly different from each other at the 5 per cent level.

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若干飼料用玉米與甜玉米品種在沙烏地 阿拉伯王國東方省之表現

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摘 要

本文係報告中華民國駐沙烏地阿拉伯王國農業技術團於民國64年春季比較兩個飼料用品種及三個甜玉米品種在沙烏地阿拉伯東部Al-Hassa綠洲之適應性試驗結果。甜玉米品種 Hawaiian Sugar 較其他品種易受高溫強日照之為害。春作玉米在 Al-Hassa 地區最合適之抽穗日數約為 60 至 63 日，而有利於高產之葉面積指數甜玉米品種為 3.5 至 4.1，飼料用品種 4.8 至 4.9。

甜玉米品種之鮮莖產量以 Hawaiian Sugar 最高，而其鮮穗產量則以 Golden Cross Bantam 較高。由此可知 Golden Cross Bantam 為較適合於 Al-Hassa 地區栽培之甜玉米品種。飼料用玉米品種臺南 5 號與臺南 11 號之乾谷產量均超過每公頃 8 公噸水準，顯示此兩種雙雜交玉米在 Al-Hassa 地區均極具發展潛力。

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