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ABSTRACT

Performance statistics are given for 71 commercial sweet corn hybrids and varieties, which were grown in at least 3 and as many as 50 trials in Hawaii between 1962 and 1965.

None of the mainland hybrids were considered commercially acceptable for year-round production in the tropics, due principally to the dwarfing effect of short winter daylengths.

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Five mainland hybrids were rated highly except for midwinter production; these were Golden Security, Iobelle, Midway, Southern Belle, and Surecrop. Southern Belle was among the few hybrids resistant to *Helminthosporium turcicum* blight, a disease often serious in Hawaii.

The data are discussed under the following headings: Overall ratings, days to harvest, plant characters, disease resistance, insect and pest resistance, ear characters, flavor and tenderness, yield, and experimental design and management.

INTRODUCTION

The development of year-round commercial sweet corn production in Hawaii faces several difficulties. Major among these is the need for adapted, disease-resistant tropical hybrids. Breeding research is underway at the University of Hawaii[2] which promises to help satisfy this need. In the meantime, a thorough evaluation of commercially available sweet corn hybrids has appeared essential. The following report covers 44 performance trials which included 70 mainland hybrids and the variety, Hawaiian Sugar, grown throughout the Islands between 1962 and 1965. Emphasis was placed on the screening-out of unsuitable hybrids and the recommendation of superior hybrids.

APPEARANCE AND PERFORMANCE OF MAINLAND HYBRIDS

The 44 experimental trials to be summarized were of two types. Most of the trials were observational nurseries, in which field scores were taken on varietal performance and quality, but from which detailed yield data were not taken. The remaining trials were yield trials in which the most promising varieties were replicated and yield data recorded and analyzed. Listed below are the experiment stations, their elevations in feet, and the planting dates (month/year) of trials from which the data will be summarized:

Oahu–Manoa (90 ft.) 3/62, 7/62, 8/62, 2/63, 10/63, 1/64, 2/64, 5/64, 11/64, 3/65, 10/65

Waimanalo (200 ft.) 3/62, 4/62, 10/63, 11/63, 2/64, 3/64, 4/64,

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[2]Brewbaker, James L. 1965. Breeding sweet corn hybrids for Hawaii. *Hawaii Farm Science* 14(1): 1–4.

5/64, 10/64, 2/65, 3/65, 6/65, 8/65

Poamoho (870 ft.) 7/62, 8/62, 3/65

Kauai–Kapaa (500 ft.) 11/63, 2/64, 6/64, 3/65, 8/65

Maui–Haleakala (2,200 ft.) 12/63, 2/63, 3/64, 4/64, 5/64

Kihei (50 ft.) 7/63

Hawaii–Lalamilo (at Kamuela, 2,700 ft.) 3/64, 8/64, 3/65, 7/65

Volcano (3,800 ft.) 8/64, 7/65

It is not possible, nor would it be useful, to present all of the data from these trials. Consequently, they have been summarized and discussed together in the 8 following sections.

1. OVERALL RATING

A summary of the major characteristics of 70 mainland varieties and hybrids is made in Table 1, with the tropically-adapted variety Hawaiian Sugar included for comparisons. Varieties included in the table were grown in at least 3 and as many as 50 different trials.

Ratings which precede the varietal names (Table 1) indicate our present evaluation of each variety. Ratings were made on a 1 to 5 scale, with 1 = best and 5 = worst. Class 1 was limited to strains of high quality, suitable to year-round production in Hawaii; none of the hybrids met these criteria. Only 5 of the hybrids (Golden Security, Iobelle, Midway, Southern Belle, Surecrop) merited our No. 2 rating, as high-quality hybrids amenable to commercial production in Hawaii in all but the winter months. Of these, Midway (an improved Golden Security) is perhaps the highest in quality, and the varieties Southern Belle and Surecrop are superior in blight resistance. Among the 23 hybrids given a No. 3 rating, however, some appear suitable to commercial production in the summer, and Florigold 107 superior in yield. In general, hybrids in the No. 4 rank appeared of limited value in Hawaii, while those in the No. 5 rank have been dropped from further UH trials.

As noted in subsequent sections, the variability was great for most characteristics, especially at different times of the year or at different experiment stations. In general, the averages in Table 1 reflect performances at the lower elevations (under 1,000 ft.), under adequate conditions of irrigation, fertilization, and light. Comparison of these data with performance specifications of the same varieties on the Mainland reveal the following major differences:

1. Sweet corn matures much earlier at low elevations in Hawaii than on the Mainland, or than at higher elevations (e.g., Kamuela) in Hawaii.

2. Ear lengths and weights, and plant heights are reduced about 15% in Hawaii compared to those on the Mainland.

3. Many outstanding mainland varieties, principally those bred for short northern summers, are essentially worthless in Hawaii.

In a technical sense, varieties[3] are strains derived from open-pollinated seeds. The only varieties incorporated in this study were Golden Bantam, Country Gentleman, Stowell's Evergreen, and Hawaii's own Hawaiian Sugar, bred under the aegis of Dr. A. J. Mangelsdorf. Sweet corn hybrids are derived from crosses of two (rarely more) inbred lines. The grower can save his own seeds from varieties, but seeds from hybrids cannot be saved for future plantings. Hybrids are much more uniform in maturity, type, and quality, and they generally outyield varieties. Essentially no commercial use is made of varieties in the United States.

2. DAYS TO HARVEST

Sweet corn hybrids mature to harvest stage in from 65 to 100 days on the Mainland. The same hybrids mature in from 60 to 78 days at lower elevations in Hawaii. In Table 1 are summarized the days to harvest in all trials except those at higher elevations (Volcano, Haleakala, and Kamuela). Much attention has been given to earliness by breeders in northern states, in part to take advantage of early summer markets, while earliness is of little importance in the tropics. Early mainland hybrids are generally unacceptable in Hawaii.

Maturity data are summarized for mainland and Hawaiian conditions in Table 2 for 21 hybrids which have been tested widely in Hawaii. (Trials at high elevations are also excluded from this summary table.) As a rule of thumb, one may estimate days to maturity in Hawaii by multiplying days to maturity on the Mainland by 85%. This shortening of growing season appears to be due largely to the short days and warm nights characteristic of Hawaii (Honolulu is at 21° 20' N. latitude).

The number of days to harvest can vary widely in Hawaii, however,

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[3]The term "variety" is also used in a more general sense in this paper, as in most literature on corn, to refer to any named strain, whether hybrid or not.

depending largely upon temperature during early growth. Plantings have been made at three stations where protracted cool weather essentially suppresses winter corn growth, and greatly retards growth in the spring plantings:

Haleakala (Makawao, Maui) 2,200 ft. elevation
Volcano (Volcano, Hawaii) 3,800 ft. elevation
Lalamilo (Kamuela, Hawaii) 2,700 ft. elevation

The sample data presented below indicate the range of variation in days to harvest for the planting dates indicated:

	Days to Harvest				
	Average Lowland	Haleakala 5/64	Kamuela 8/64	Kamuela 3/64	Volcano 8/64
Golden Cross Bantam	70	86	89	101	124
Hawaiian Sugar	78	97	112	118	140

At higher elevations, plantings made between April and September mature essentially as they would on the Mainland (e.g., Golden Cross Bantam in 85 days).

Days from pollination to harvest in Hawaii range from 17 to 19 for choice, fresh market corn. The rapid loss of quality after these dates should discourage delaying harvests in order to obtain the slight increase in ear weight (a practice that would be reduced if handling and marketing were on the basis of number of ears).

3. PLANT CHARACTERS

Plant heights of the 70 mainland varieties (Table 1) generally averaged less than 6 feet, and were highly variable during the year. Although midsummer growth approaches that attained on the Mainland, average heights are reduced about 20% from mainland values. The ear height (measured to node below uppermost ear) is similarly reduced in Hawaii. Midwinter dwarfing is well known to all who have planted temperate sweet corn in the tropics; ears are often so low that rat and bird damage are severe.

Suckering (tillering) is very uncommon in Hawaiian Sugar and in other tropical sweet corn varieties such as Pajimaca, USDA 34, and Chiripo Dulce. However, it is common in many mainland hybrids grown in the tropics and is perhaps detrimental to yields in some plantings. Most hybrids have 2 or 3 small suckers. There are often wide variations in suckering, apparently unrelated to seasonal differences.

TABLE 1. Average records of 71 commercial sweet corn varieties grown in Hawaii

Evaluation*	Variety	No. of Trials	Seed Source	Days to Harvest*	Plant Height (ft)	Height to top Ear (ft)	Blight Resistance	Ear Length (in)	Row No.	10-Ear Weight (lb)	Ear-worm*	Sweetness*	Tenderness*	Yield in % of Check*
3	Aristogold Bantam Evergreen	12	B+	70	6½	2½	F	7	16	7.1	3	2.7	2.7	80.4
5	Barbecue	8	H+	65	4	1½	P	5½	12	3.2	3½	2.9	2.3	–
5	Big Chief	17	H	70	6	2½	P	7	16	5.7	4½	2.5	3.1	93.8
3	Buttertender	8	NK	72	5	2½	F	6	16	4.8	3½	2.3	1.3	–
3	Calumet	8	A+	72	7	2½	P	7¼	14	4.9	2½	2.8	2.3	97.1
5	Carmel Cross	4	A+	65	4	1½	P	6	16	4.6	3½	2.3	2.5	–
5	Dixie Blend	8	NK	72	6	2	F	7	14	5.6	3	2.5	2.3	96.3
4	Duet	8	A+	70	6	2	F	7	14	4.4	2½	3.0	1.9	92.2
	Floribelle	3	SRS	67	5½	2	P	7	16	5.6	3	3.2	3.0	–
4	Florigold 106	6	A+	71	6	2½	F	7	16	5.8	2½	2.9	2.9	–
3	Florigold 107	10	A+	72	6	2½	F	6½	14	5.4	2½	2.9	3.3	128.1
3	FM Cross	14	FM+	68	5½	2	P	6	14	4.9	3	2.6	1.9	103.0
3	Gold Cup	17	H	72	5½	2	P	6	14	4.8	3½	2.0	2.0	111.6
3	Gold Eagle	8	H	72	6	2½	P	6½	14	5.2	3	2.8	3.1	104.8
4	Golden Bantam	16	FM+	66	5	2	P	7	8	3.9	4	1.7	1.8	66.9
3	Golden Bounty	8	NK	69	6	2½	P	6½	12	4.8	3	2.3	2.0	–
3	Golden Bouquet	5		72	5½	2	F	6½	12	4.7	2½	2.3	3.0	–

3	Golden Cross Bantam	36	FM+	70	5½	2	P	6	12	5.1	3	2.1	1.8	90.5
3	Golden Giant	8	W	71	6	2½	P	7	12	5.2	3	2.1	2.8	57.8
4	Golden Monarch	8	NK	73	7	2½	P	7	16	5.7	3	2.9	2.7	81.4
2	Golden Security	38	A+	71	6½	2	P	7	14	5.1	2½	2.3	1.9	100.0
3	Golden Valley	9	NK	75	6½	2½	P	6½	14	4.8	2½	2.2	2.7	91.0
3	Hawaiian Sugar	50	UH	78	8½	4	F	7	14	4.9	1½	3.0	3.2	114.7
3	Honey Cross	8	B	72	6½	2½	F	6½	14	5.4	3	2.8	2.4	89.2
5	Hybrid G7	4	NK	64	3½	1½	P	5	8	2.7	3	1.5	2.0	–
5	Hybrid M13	3	NK	64	4	2	F	5½	8	2.6	3½	1.5	2.0	–
4	Hybrid 1710	8	NK	69	5½	2	P	6	14	3.9	3	2.6	2.9	71.9
3	Ioana	23	FM+	70	6	2	P	6½	12	4.9	3½	2.6	2.4	91.2
2	Iobelle (= Florigold 104)	22	FM	73	6½	2½	F	6½	14	6.0	2½	2.9	2.1	103.6
4	Iochief	23	NK+	71	6	2½	P	6½	16	5.0	3½	2.3	2.2	95.7
	Longchief	3	SRS	70	6	2½	P	8	16	6.7	3½	3.0	2.5	–
5	Marcross	5	NK+	64	3½	1	P	5½	12	4.6	4	2.5	3.0	–
3	Merit	8	A+	69	6	2½	P	7	16	6.1	3	2.6	2.6	97.8
2	Midway	8	A	72	6½	2½	P	6½	16	5.4	2½	1.7	1.4	101.8
5	NK72	3	NK	63	3½	1	P	6	12	2.8	4½	2.0	2.5	–
4	NK75 (=Queen Anne)	8	NK	65	4	1½	P	6	12	3.8	3	2.9	3.1	89.5
4	NK81	7	NK	70	5½	2	P	6½	14	6.2	2½	1.9	2.1	–

(Continued)

TABLE 1. Average records of 71 commercial sweet corn varieties grown in Hawaii (Continued)

Evaluation*	Variety	No. of Trials	Seed Source	Days to Harvest*	Plant Height (ft)	Height to top Ear (ft)	Blight Resistance	Ear Length (in)	Row No.	10-Ear Weight (lb)	Ear-worm*	Sweetness*	Tenderness*	Yield in % of Check*
3	NK87	8	NK	72	6½	2½	F	7	16	6.2	2	2.6	2.1	80.0
3	NK 195	7	NK	70	6	2½	P	6½	14	4.2	2½	3.1	1.6	70.9
3	NK 199 (= Butter Sweet)	10	NK+	70	6½	3	F	7	18	6.2	3	2.6	2.2	94.3
3	NK 1304	21	NK+	72	6½	2	F	7	12	4.9	3	2.2	2.9	98.7
4	NK 51036	8	NK	68	5	2	F	6	14	5.0	2½	2.5	2.7	94.3
5	North Star	5	H	62	3½	1	P	6	12	2.5	4½	3.0	2.5	–
4	Northern Belle	11	H	64	4½	1½	P	6	14	4.7	3½	1.9	2.3	112.9
	Pioneer 3-Way Hybrid	3	P	70	5	2	F	7	12	–	2½	2.0	2.0	–
5	Seneca 60	8	R	60	3	1½	P	5	10	4.2	3½	2.3	2.0	–
4	Seneca Chief	6	R+	69	5	1½	P	6	12	4.6	2½	1.7	1.6	63.8
2	Southern Belle	11	H	72	6½	2	G	7½	14	5.7	2½	2.5	2.6	109.7
5	Spring Gold	8	H	64	4	1	P	5	12	2.5	4½	3.0	2.0	–
	SRS Cross	3	SRS	68	6	2	P	7½	16	7.1	3	2.8	3.0	–
	SRS 3373	3	SRS	67	6	2	P	7½	16	6.6	2½	3.0	2.5	–
3	Sugar King	6	NK+	65	5	2	P	7	14	4.9	3	1.9	1.2	67.8
2	Surecrop	6	H	71	7	2½	F	6½	14	5.1	2	2.0	2.5	126.4
4	Surecross	5	B	68	5½	1½	P	6½	14	5.5	2½	2.2	1.9	–

3	Sweetex No. 2	3	Tex	75	7½	3½	G	7½	12	6.9	1½	3.2	3.0	–
	Tendercrisp	3	SRS	66	5½	2	P	7	14	7.1	3	2.5	2.5	–
	Tendermost H	3	G	68	6	2	P	7½	18	7.1	3	2.7	2.0	–
3	Victory Golden	13	A+	75	7	2½	P	7	14	5.7	2	2.3	1.6	100.3
4	Wintergarden	12	A+	75	5½	1½	F	6½	14	5.7	3	2.6	1.8	77.6
3	Wintergreen	10	A+	70	5	2½	G	6½	14	6.0	2½	2.8	2.9	97.7
3	Wonderful	16	H	69	5½	2	P	6½	12	4.8	3	1.8	1.6	105.4
	WHITES:													
5	Country Gentleman	9	FM+	78	6½	2½	P	5½	None	4.6	3½	1.9	1.6	75.3
4	Honey and Cream	6	H+	65	5	2	P	5	12	3.7	3½	2.8	1.6	–
4	Illinois 14 x 11	5	H+	75	8½	3	F	7	16	6.3	2½	2.6	2.9	84.5
4	Iogreen 56	8	NK	73	7½	3	P	7	16	5.9	2½	2.9	2.8	65.9
4	Iogreen 91	5	NK	74	7½	3	P	7½	16	7.0	2	2.8	3.0	–
4	Royal Gent	4	NK	77	6½	2½	P	7½	None	5.4	3	2.6	3.1	61.4
3	Silver Queen	4	RB+	72	6½	2½	F	7	14	5.7	2	1.8	1.6	109.8
4	Snow Cross	4	B	71	7	2½	P	7	14	5.4	3	3.1	3.8	76.4
4	Stowell's Evergreen	8	FM+	74	8	2½	F	8	16	5.5	3	2.1	2.8	–
4	Stowell's Evergreen Hybrid	6	FM+	72	7½	3	F	7½	16	5.9	3½	3.6	3.7	85.1

(Continued)

TABLE 1. Average records of 71 commercial sweet corn varieties grown in Hawaii (Continued)

* KEYS:

Evaluation:
1 – Acceptable for year-round commercial production.
2 – Acceptable for March to October commercial production.
3 – Fair summer growth; decided limitations of commercial use.
4 – Of doubtful or limited value.
5 – Unacceptable in Hawaii.
Unlabelled – Insufficient trials.

Seed Source: (+ indicates that there are several possible sources)
A – Asgrow Seed, Milford, Conn.
B – Burpee Seed, Riverside, Calif.
G – Gill Bros., Portland, Ore.
FM – Ferry Morse Seed Co., Salinas, Calif.
H – Joseph Harris Seed Co., Rochester, N.Y.
NK – Northrup-King & Co., Minneapolis, Minn.
P – Pioneer Seed Co., Johnston, Iowa
RB – Rogers Bros. Seed Co., Idaho Falls, Idaho
R – Robson Seed Farm, Hall, N.Y.
SRS – Seed Research Specialists, Gilroy, Calif.
T – Texas A & M, College Sta., Texas
W – Woods, Richmond, Va.
UH – Univ. of Hawaii, Dept. of Horticulture

Days to Harvest: Averages are computed for those Stations at elevations under 2500 ft.

Blight Resistance: G = Good; F = Fair; P = Poor.

Earworm, Sweetness, and Tenderness Ratings: 1 = Highly acceptable, to 5 = Unacceptable.

Yield: Harvested ears in percent of check variety, Golden Security.

Lodging was observed rarely among commercial hybrids. The combination of prolonged, heavy rains and strong winds will topple any hybrid, of course. The tall Hawaiian Sugar and certain hybrids derived from it are quite susceptible to lodging, especially in the fifth to seventh weeks of growth.

4. DISEASE RESISTANCE

The two major diseases of sweet corn in Hawaii are sweet corn mosaic and the Northern leaf blight (*Helminthosporium turcicum*). Brewbaker and Aquilizan[4] have shown that all mainland hybrids and varieties are fully susceptible to mosaic (known as "corn stripe" in Central America), transmitted by the leafhopper, *Peregrinus maidis*. It is not uncommon to observe 20 to 40% of the plants among commercial hybrids stunted to nonflowering dwarfs by mosaic. A classical symptom of mosaic is the chlorotic striping of leaf veins. Mosaic is seen in all seasons in Hawaii, but is of greatest severity in winter months. In most areas, therefore, leafhopper populations should be held in check by spray (DDT, Malathion) for commercial production of mainland hybrids.

Leaf blight (see Table 1) is occasionally severe in Hawaii, especially under cool moist conditions, or with sprinkler irrigation. These conditions account also for the severity of *Helminthosporium* in spring plantings in southern states, where regular spray programs (commonly, weekly applications of Maneb or similar fungicides) are enforced during growing seasons. Genetic resistance occurs in a few sweet corn hybrids, and breeders are adding new resistant hybrids each year. Only three hybrids showed high resistance in our plantings: Southern Belle, Sweetex No. 2, and Wintergreen. Many varieties showed sufficient resistance ("F" in Table 1) that the blight produced little or no reduction of yield, since severe leaf burning occurred too late to affect ear development. Yields of susceptible lines were depressed most conspicuously by blight in experiments at Volcano and Kamuela on the island of Hawaii and at Kapaa on Kauai.

5. INSECT AND PEST RESISTANCE

Corn has comparatively few insect pests, but two of them—the corn earworm (*Heliothis armigera*) and the leafhopper, *Peregrinus maidis*—can greatly reduce yields. Spray control of the leafhopper is comparatively simple, as noted in the previous section. No genetic resistance to this leafhopper was observed.

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[4]Brewbaker, James L., and Flaviano Aquilizan. 1965. Genetics of resistance in maize to a mosaic-stripe virus transmitted by *Peregrinus maidis*. Crop Science 5: 412–415.

TABLE 2. Days to harvest of 21 hybrids on the Mainland and at lower elevations in Hawaii

Variety	Days to Maturity		
	Average Mainland	Average Hawaii	Range Hawaii
North Star	67	62	60–68
Northern Belle	74	64	62–72
Golden Bantam	68	66	62–72
Gold Cup	80	72	70–74
FM Cross	81	68	62–74
Wonderful	82	69	64–75
Southern Belle	84	72	67–79
Golden Security	84	71	63–77
Golden Cross Bantam	85	70	65–77
NK 1304	85	72	66–77
NK 199	85	70	63–77
Aristogold Bantam Evergreen	85	70	68–77
Ioana	86	70	66–77
Iochief	87	71	65–77
Wintergarden	87	75	71–79
Victory Golden	88	75	71–79
Iobelle	88	73	68–85
Stowell's Evergreen	95	74	69–85
Iogreen 56	95	73	69–81
Country Gentleman	95	78	75–85
Hawaiian Sugar	– *	78	67–88

* No data.

Few mainland hybrids showed any convincing earworm resistance (Table 1). Early-maturing hybrids were severely infected with earworms, and Sweetex No. 2 was the only hybrid as resistant as Hawaiian Sugar or Pajimaca. Five additional mainland hybrids were considered moderately resistant; these were Iogreen 91, NK 87, Surecrop, Silver Queen, and Victory Golden. The tight husks of these hybrids and of tropical varieties usually reduce the cannibalistic earworms to one per ear, and confine feeding to silks and ear tips.

Control of the corn earworm deserves more intensive study in Hawaii. The conditions created by constant corn planting and harvest in commercial

fields are ideal to earworm buildup, and it is the rare ear that escapes infestation. While Hawaii's markets accept decapitated ears, with the worm-infested regions removed, the attendant loss of quality is great. Earworms can be controlled by 3 to 5 applications during silking of insecticides such as carbaryl (trade name, Sevin) at the recommended rate (2 pounds/acre for Sevin).

Occasional pests of corn in Hawaii include the rose beetle (*Adoretus sinicus*), several aphids including the corn aphid (*Aphis maidis*), and pineapple beetles (Nitidulidae). Ears opened by the earworm (which leaves a small exit hole, usually prior to harvest stage) may be damaged by the pineapple beetles and accompanying molds, bacteria and yeasts.

Several pests sporadically reduce corn yields in Hawaii. Rats have caused severe damage in certain commercial plantings, but have not been a problem in experimental plantings. Pheasant damage has been observed on the very low ears of early mainland hybrids. Seeds are occasionally pulled up by discerning Mynah birds and doves when the seeds are poorly covered. The birds show a decided preference for waxy (glutinous) and starchy field corns over the sugary sweet corn seeds.

6. EAR CHARACTERS

Data have been recorded in Table 1 for ear lengths, ear weights (unhusked), and numbers of rows of seeds per ear. Data have not been recorded for ear diameter, size of flag leaves (tips of ear husks), percent husks, shank lengths, tip taper, and tip fill, since they appear to be little different in Hawaii from specifications of seed producers. Our tests have included all types of corn, ranging from the 8-rowed miniatures and garden types to the canning types with high row counts. The low variability of ear row count is confirmed by our studies; we tend to find, however, that ear row numbers in Hawaii are at the lower end of ranges specified by seed producers. As noted earlier, ear lengths were shortened (about 15%) in Hawaii compared to mainland values (Table 3). Reduction in ear length is most notable in winter months, while the lengths obtained in midsummer often attain seed-producer specifications.

Ear weights averaged nearly ½ lb. for the better hybrids. Weights varied widely and the averages in Table 1 should be viewed accordingly. Ear weights in Hawaii average about 85% of those on the Mainland. The husked weights ranged between 65 and 70% of unhusked weights for nearly all hybrids (major exceptions: Hawaiian Sugar and Sweetex No. 2, 55 to

60%). It is to be hoped that sweet corn marketing in Hawaii will follow mainland fresh corn practices of handling ears by the number, rather than by the pound. The adoption of the 5-dozen or 6-dozen carton would greatly facilitate this marketing.

The trials summarized in Table 1 have included both white and yellow sweet corns. There is presently little or no interest in commercial production of whites in Hawaii, although the hybrid Silver Queen is often delicious here, and some of the Evergreen types yield well. The mixed yellow-white Honey and Cream is unadapted here. Although whites must not be allowed to pollinate with yellows, judicious timing of planting dates would permit intercropping.

TABLE 3. Plant heights and ear lengths of 21 varieties in Hawaii and on the Mainland

Variety	Average Plant Height		Average Ear Length	
	Hawaii	Mainland	Hawaii	Mainland
	feet		inches	
Aristogold Bantam Evergreen	6½	8½	7	8
Country Gentleman	6	7	5½	7
FM Cross	5½	6½	6	8
Gold Cup	5½	6½	6	7½
Golden Bantam	5	4½	7	7
Golden Cross Bantam	5½	6½	6	8
Golden Security	6½	7½	7	8
Golden Valley	6½	7	6½	8
Ioana	6	6	6½	7½
Iobelle	6½	6	6½	7½
Iochief	6	7	6½	8½
Iogreen 56	7½	8	7	7½
NK 1304	6½	8	7	8
Midway	6½	7	6½	8½
North Star	3½	5	6	7
Northern Belle	4½	6	6	7½
Southern Belle	6½	7½	7½	8½
Stowell's Evergreen	8	8	8	8
Stowell's Evergreen Hybrid	7	7½	7	8
Surecrop	7	7	6½	8
Wintergarden	5½	6½	6½	8
Average	6.1	6.8	6.6	7.8

7. FLAVOR AND TENDERNESS

Short days and warm nights are hardly ideal for the development of sweetness in most vegetables, and corn is no exception. The flavor of mainland hybrids often is disappointing in Hawaii, particularly in the winter months. Two weeks of cool gray weather prior to harvest in the winter is sufficient to reduce almost any mainland variety to a pallid, chewy caricature of this fine vegetable. Nonetheless, the sweetness ratings in Hawaii (Table 1) appear to correlate well with those on the Mainland, and few hybrids could be discarded on this basis alone.

Similarly, tenderness ratings of most commercial hybrids were acceptable in Hawaii (those averaging 3.0 or more can be considered poor). Tenderness is lost rapidly, between 20 and 22 days after pollination. The rapid development of the ear, and of the pericarp in particular, is correlated with the telescoping of growing seasons by tropical daylengths. Harvesting on alternate days (3 or 4 pickings per hybrid) is advisable to ensure a high quality product. Therefore, biweekly plantings of two hybrids, differing one week in maturity, should be adequate for year-round harvest in Hawaii.

Quality ratings were based largely on field samples of the raw vegetable, and generally correlated well with puncture tests and tests of cooked ears. While difficult to measure, the extraordinary "corn" flavor of hybrids like Golden Cross Bantam and Seneca Chief are discerned readily in Hawaii (most noticeably in summer months). Quality of ears harvested at Kamuela seemed, to the senior author at least, to be unusually high.

8. YIELD

Yield information has been recorded in 15 of our performance trials, of which 8 trials were replicated. Variations in yield among planting dates and locations have been assessed in unreplicated trials, prior to the establishment of highly-replicated trials at any one location. Therefore, most of the yield data are not prone to intensive statistical analyses.

In Table 1, yields are presented for all hybrids which were evaluated in three or more experiments. The data represent total ears harvested, converted to percents of the standard check hybrid, Golden Security. This hybrid is one of the highest yielding on the Mainland, but has largely been replaced in commercial production by hybrids (e.g., Midway, Iobelle) with better quality or disease resistance. Golden Security yields in the 15 trials averaged 20,145 harvestable ears per acre and ranged from 11,920 to 31,360. In a typical trial, these estimates are based on small, single-row plots, 30 to 50 feet in length, with plants spaced 10 inches apart in rows 3 feet apart.

Yield data are further summarized in Table 4 for all hybrids which have been included in four or more yield trials. The data are expressed as percents of the check variety, Golden Security, grown in the same trial. The 18 varieties ranged from a minimum of 67% (for the noncommercial Golden Bantam) to a high of 128% (Florigold 107). While the variations in absolute yields between trials were large, the adjustment of yields to a standard check removed much of this variation. It appears that similar adjustments should be made in future yield trials, preferably with the designation of a blight-resistant hybrid as check variety. The computed $LSD_{.05}$ in Table 4 of 15% is based on averages in the table, rather than on original data (total of 27 replications), and thus may be taken as a maximal value.

Many new hapa-Hawaiian hybrids are being bred at the University of Hawaii, and most of these significantly outyield Golden Security in seasons other than the midsummer months. One of the most promising of these hybrids, Hawaiian Gold H38, has outyielded Golden Security by 77.2% in the four trials (each replicated twice) in which the hybrids have been paired.

It should be emphasized that the yields in Tables 1 and 4 are useful principally for comparisons within the tables, and not for extrapolation to commercial field conditions. Many of these trials were conducted in the winter, or conducted without blight or earworm control, in order to assess native resistance to these conditions, and yields were accordingly variable. Large replicated yield trials of outstanding hybrids will be made to provide yield data of more direct value to the producer.

None of the hybrids (Table 1) produced more than 50% second ears when planted in stands of 15,000 or more plants per acre. Available evidence indicates that the yield of uniformly top-grade ears of sweet corn is greatest when stand is adjusted so that plants average one harvestable ear. This is attained with populations in excess of 20,000 plants per acre on well-fertilized soil in Hawaii's lowlands. Preliminary studies indicate that, while lower stands may permit slightly higher yields, a much higher proportion of the ears are short and substandard.

EXPERIMENTAL DESIGN AND MANAGEMENT OF PERFORMANCE TRIALS

In Hawaii, it is imperative that corn hybrids be evaluated and observed throughout the year, at locations differing in elevation, cloud cover, disease

TABLE 4. Ears harvested in percent of check variety, Golden Security, in 15 yield trials (2 replications each for Oahu trials, 4 replications Maui, 1 replication on other islands)

Variety	Oahu						Maui		Kauai				Hawaii			Average*
	4/64	5/64	10/64	3/65	3/65	8/65	4/64	5/64	11/63	6/64	3/65	8/65	8/64	3/65	7/65	
Aristogold Bantam Evergreen				75.0						76.0		97.6		94.6	58.9	80.4
Big Chief			105.7		50.0		67.1	71.6	108.6	79.3	109.5	117.1		90.4	138.4	93.8
Florigold 107						138.4							130.5	110.0	133.6	128.1
Gold Cup	123.2		112.6	129.5	68.8						95.2	112.2	113.3	137.7		111.6
Golden Bantam	89.9				50.0				74.1	57.3		63.4				66.9
Golden Cross Bantam	97.8	77.9	112.6	88.5	75.0	102.7	69.0	75.9	121.0	76.0	95.2	115.9	51.5	69.2	129.5	90.5
Hawaiian Sugar	130.4	123.7		103.3			113.9	107.1	130.9	132.7		131.7	60.9	111.9		114.7
Ioana	91.3		114.9	48.4	100.0				92.6	78.7		63.4		79.2	152.1	91.2
Iobelle	129.0		110.3	79.5	100.0	101.4	83.5	89.4			76.2	132.9	102.1	135.0		103.6
Iochief	104.3	93.9	125.3	79.5			63.3	70.9	104.9	96.7		97.6		63.8	152.1	95.7
NK 199 (Butter Sweet)					62.5						116.7	104.9		93.1		94.3
NK 1304	104.3				75.0		63.3	80.1	129.6	100.7	114.3	122.0				98.7
Southern Belle	134.1				75.0				135.8	83.3	114.3	115.9				109.7
Victory Golden	102.9		92.0	122.1	93.8		83.5	85.1	103.7			119.5				100.3
Wintergarden	84.8		67.8				65.2	70.9					85.8	82.7	86.3	77.6
Wintergreen					62.5						95.2	124.4	81.1	76.9	145.9	97.7
Wonderful	115.2			83.6	75.0				155.6	93.3	100.00	113.4		96.5	115.8	105.4
Stowell's Evergreen Hybrid					87.5				93.8	58.0	76.2	109.8				85.1

*LSD (P = .05) = 15.1

conditions, etc. Therefore, replication is gained in time, and fewer replications are used at any single planting. Customarily, we have planted randomized complete block designs with 2 replications, avoiding time-consuming statistical analyses where possible in favor of time spent in field examinations.

Management conditions differed sufficiently at the 8 stations on the 4 islands that they are reviewed individually here.

1. TRIALS ON THE ISLAND OF HAWAII

Major trials were conducted at the Volcano and Lalamilo Farms, with observational plantings at the Waiakea (Hilo) and Hamakua Farms. The soil at the Volcano Farm is classified as a Hydrol Humic Latosol, and the annual rainfall is about 160 inches. The farm is at 3,800 feet elevation, and temperatures range from 40° to 70° F. The soil at the Lalamilo Farm is a reddish Prairie soil and the annual rainfall is about 40 inches. The farm is at 2,700 feet elevation, and temperatures range from 45° to 75° F.

Plants were spaced 9 inches apart in rows 3 feet apart at all stations. Single rod-row plots were planted at Volcano, with 2-row plots at Lalamilo.

Fertilization was with preplant applications of 150N, 300P, and 150K per acre, followed by side-dressings of 50N, 50P, and 25K per acre. Atrazine and aromatic oils were used for weed control, and some earworm control was practiced with DDT.

The Volcano Farm, although too cold for winter corn production, produced high quality summer crops in 80 to 120 days. At Lalamilo, winter production is feasible if perhaps hazardous, and growing seasons are long. Protection from tradewinds is necessary or highly desirable.

At all Farms on Hawaii, *Helminthosporium* blight was a serious problem. Earworm damage was noted, but was rarely severe. Quality was exceptionally high at the Volcano Farm.

2. TRIALS ON THE ISLAND OF KAUAI

All trials were conducted at the Kapaa Station, on a Halii gravely silty clay soil at 500 feet elevation. The annual rainfall in this area is about 90 inches. Although high seasonal rainfall provides a complication to planting, temperatures are suitable for year-round production in this area (range, 58°–88° F.).

Plants were spaced 10 to 12 inches apart in rows 30 inches apart, and single 40-foot plots were grown, usually with 2 replications. The area was limed at a rate of 2½ tons/acre in 1964. Preplant fertilizers were disked in, usually at a rate of 90N, 250P, and 100K per acre (as urea, treble superphosphate, and potassium sulfate), with zinc chelate added at a rate of 3 pounds Zn per acre. Applications of 750 lb/acre of 7-30-21 have also been used, with split applications at planting and as a side dressing when corn was 2 feet tall. Atrazine at 4 lb/acre was used as a preemergent herbicide. Occasional DDT sprays were applied for rose beetle and leafhopper control.

Helminthosporium blight was severe in this area, and fungicide applications or resistance therefore highly desirable. Yields were otherwise excellent and these trials were among the most intensively studied for horticultural characters.

3. TRIALS ON THE ISLAND OF MAUI

Trials were conducted at the Haleakala Farm, near Makawao, with an observational planting at Kihei (a typical dry, hot leeward area). The soil at the Haleakala Farm is classified in the Makawao series of humic latosols, and the annual rainfall is about 75 inches. The Farm is at 2,200 feet elevation, and temperatures range from 48° to 79° F.

Plants were spaced 12 inches apart in rows 3 feet apart. Two or four replications were planted of rod-row plots. Fertilization was made with preplant applications of 600 lb/acre of 10-20-20, followed by side dressing of 400 lb/acre of 10-20-20. Winter production of sweet corn in the Kula or Haleakala Farm areas is perhaps feasible, but inadvisable. Excellent year-round production is possible at lower elevations on Maui and Molokai. Blight does not present a problem in the drier areas, but earworm control would be necessary.

4. TRIALS ON THE ISLAND OF OAHU

Oahu trials have been conducted at three locations. The Manoa Farm, located on the University of Hawaii campus, has been used principally in conjunction with biochemical and pollination studies not reported here. The soil is a high quality silty clay of the Manoa or Makiki series, and rainfall averages 65 inches. The elevation is about 100 feet and temperatures range from 65° to 90° F. Plants were spaced 12 inches apart in rows 4 feet apart (to facilitate pollination and inspection) and row lengths varied. Preplant fertilization with about 500 lb/acre of 8-12-14 was followed by a side dressing of 300 lb/acre of ammophos. Atrazine (4 lb/acre), hand weeding, and

DDT sprays were applied regularly or sporadically. Earworms were ubiquitous and blight rarely a problem at this location.

The Waimanalo Farm is situated at 200 feet elevation and has a high magnesium clay soil of the Waimanalo series. Annual rainfall averages 90 inches and is highly seasonal. The heavy clay soil drains slowly and often cannot be prepared during the wet months, although judicious pre-preparation and atrazine weed control would facilitate year-round plantings. In this area, nutgrass (*Cyperus rotundus*) presents a major weed problem, and preplant treatments with eptam (2 qt/acre) and with postemergent oil sprays have helped to hold it in check. Temperatures range from 60° to 85° F., and cloud cover is greater than at other trial areas on Oahu. Winter dwarfing of mainland hybrids was conspicuous at this station. Plants at Waimanalo were spaced 12 inches apart in rows 3 or 4 feet apart, and single row plots 30 feet long were commonly used. Fertilization was with 600 lb/acre of 15-15-15 at time of planting, followed by a side dressing of 200 lb/acre of ammonium sulfate or urea. Mosaic and earworms caused severe injury at Waimanalo. *Helminthosporium* was first observed in 1964, and is now very common especially in prolonged wet seasons.

The Poamoho Farm is at 700 feet elevation on a Low Humic Latosol of the Wahiawa series, with a low annual rainfall of 40 inches and temperature range of 60° to 90° F. Plants were spaced 12 inches apart in rows 4 feet apart, and a row length of 30 feet was used in most trials. Fields were fertilized with about 400 lb/acre of ammophos (11-48), followed by a side dressing of 200 lb/acre. Weed control was achieved with Randox and Cyanox both at 1 gallon (4 lb.) per acre. Winter growth in this area was superior to that of all other trial areas, and planting throughout the year was facilitated by the low rainfall and excellent drainage.

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