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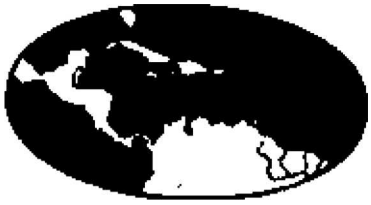

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PERFORMANCE OF FOURTEEN ELITES AT TWO LOCATIONS IN SURINAME

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SUMMARY

Sixteen varieties, fourteen elites from CIMMYT (maize and wheat improvement center) and two local floury flints were tested at two different locations on two types of soil.

1. Tijgerkreek West, with a fine sandy loam soil of medium fertility on coastal area; derived from Demerara formation.
2. Coebiti, with a coarse sandy loam soil of poor fertility and low pH; derived from Zanderij formation.

Compared to local cultivars, CIMMYT elites produced outstanding grain yields of an approximately 7,000 kg per hectare at Tijgerkreek West whereas the local checks produced a maximum grain yield of 5,000 kg per hectare. On the Zanderij formation, at Coebiti the grain yields were depressed by almost fifty percent of those at Tijgerkreek West. A significant correlation was found between number of leaves (per plant) and plant height. Plant height and grain yield were negatively correlated.

INTRODUCTION

Hybrids are recognized by their vigorous growths, high yields and uniformity which result from crossing two dissimilar parents, but these features are lost in the second generation. This means that with hybrid maize the farmer has to buy new seed each year, indicating in many cases a serious drawback for the small peasant farmers in developing countries who usually prefer to keep his own seed. For that reason the maize breeding program in developing countries is at present more concpntrated on improvement by means of open-pollinated varieties. Bolton (1977) summarized the advantages of a maize breeding program aimed at the production of improved open-pollinated varieties as follows:

1. Seed can be saved from each seasons crop for planting the following season; unlike hybrid seed;
2. The yield can be maintained with simple selection methods.
3. Open- pollinated varieties can be made available in the very early stages of the breeding program whereas hybrid varieties only emerge after completion of the entire breeding process.

Under bad husbandry conditions hybrids and new varieties with a high yield potential will yield no more than local varieties. It means that the introduction of high yielding cultivars should follow, not precede good cultural practices as they are bred to perform well under favourable growing conditions.

In recent varietal trials at the experiment station local synthetics and composites produced grain yields of 5,000 kilograms per hectare on the average at a plant population of about 40,000 plants per hectare, but low yields of 2 to 2.5 tons per hectare were common in the previous

years due to the low plant populations used. There is a growing need for superior cultivars with high and consistent grain yields in Suriname to boost corn production which had tremendously decreased in recent years (Lata, 1978).

The elites used in the present varietal trials were developed at CIMMYT International experimental varieties which were tested at 25 to 30 locations: which in turn were developed from International progeny testing trials. Elites, which are superior in grain yield and other features are tested at 100 to 125 locations. The best performing elites in each country are moved into national demonstration trials and considered for national release. In the present Elite trials 14 elites (1977) along with two local checks were tested at two locations on different types of soil to compare the growth and yield of all varieties (at two locations) and the elites with local ones. At Tijgerkreek West two elite trials were carried out; one in 1977, long rainy season, (code no TK 129) and the other in 1977 short rainy season (TK 150). At Coebiti the trial (no Co 116) was conducted in the short rainy season (Dec.-January) with a week's difference in the sowing date from TK 150. As there were no significant differences in plant height measurement etc. between TK 129 and TK 150 only the grain yields and rainfall data are presented from the trial TK 129, but comparisions are made for the two locations Tijgerkreek West and Coebiti from the results of two simultaneous trials, TK 150 and Co. 116.

MATERIALS AND METHODS

Location and climate of Suriname

Suriname is situated between 2^{o} and 6^{o} North latitude and 54^{o} and 58^{o} West longitude, on the northeast coast of South America. Annual mean temperature is $27.1^{o}C$ with insignificant differences between months. At daytime the average maximum is $30.9^{o}C$. The daylength varies from 11h46 – 12h28. The relative humidity is rather high throughout the year with the lowest (76%) in November and the (average) highest (86%) in June. Rainfall is abundant for maize, though erratic in distribution. The average annual rainfall is 2300 mm with about ± 1,200 mm in the major rainy season (May-September) and about ± 900 mm in the minor rainy season (November to January). The wind velocity ranges between 1.1 and 1.7 m per sec.

The soil at location 1, Tijgerkreek West is sandy loam with medium fertility derived from Demerara formation) and at location II. Coebiti is well drained coarse sandy loam with very low organic matter and pH derived from Zanderij formation (see table 1.)

Table 1. Soil Analysis (depth 0-30 cm)

	Tijgerkreek-West	Coebiti
pH – H_2O	7.0	5.0
pH – KCl	6.4	3.9
EC 2½	0.24 mmho/cm	0.05 mmho/cm
C (W.B.) %	1.11	0.71
Org. matter	2.49	1.60
P (Truog)	32 ppm	6 ppm
Available K_2O (3% acetic acid)	110 ppm	15 ppm
Available MgO (3% acetic acid)	780 ppm	15 ppm
Available SO4 (3% acetic acid)	10 ppm	35 ppm
Percentage of sand (53 mu)	70.0	81
Percentage of silt (2-53 mu)	15.5	4
Percentage of lutum (2 mu)	14.6	15
Texture	Fine Sandy loam	Coarse Sandy loam
Water holding capacity: Available moisture (50 cm top soil)	140 mm	60 mm

The origin and name of each cultivar used is given in table 2. The layout was a randomized block design with four replications. The row distance was 75 centimeters and the plant distance was 50 centimeters with two plants per hole, giving a plant population of 53,333 plants per hectare. (suggested by CIMMYT). In each plot 4 rows were planted which were 5 meter long and two middle rows including the end plants were harvested for grain yield. Grain yields were adjusted to 14% moisture. Measurements of plant height (up to the flag node), ear height (up to the topmost ear), number of leaves per plant were taken after fifty percent silking. Days were counted from planting to fifty percent silking as a measure of maturity. At TKW the total amount of fertilizers used was 250kg urea, 300 kg sulphate of potash and 100 kg double super phosphate split into three applications at planting, four weeks after planting and seven weeks after planting. All phosphate was applied at planting. At Coebiti 217.5 kg urea 209.3 kg double super phosphate and 300kg sulphate of potash per hectare were applied (split) in three applications as for TKW. Chlordane 1 gm/m^2) and Furadan (15 gm/10 meter row) were used at planting and 4 weeks after planting, respectively, against mole crickets and *Spodoptera frugiperda* which are the major problems in corn growing in Suriname.

Total rainfall during the three growth periods were 636.9 and 471.1 mm at Tijgerkreek West and 468.9 mm at Coebiti. Weekly rainfall in growth period is plotted in figure 1 for both locations and also for the prevous elite trial (TK 129).

Table 2. International Elite Variety Trial, 1977, ELVT 18 (Ensayo International de Variedad Elite, 1977. ELVT 18)

Location: 1. Tijgerkreek-West 2. Coebiti

Entry No.			Parent AU Population	Origin	Replication			
					1	2	3	4
1.	Across 7422 (White)	Across Location	Mezcla trop. Blanco	PR 76B Lote 1B	2	18	37	56
2.	Poza Rica 7523 (White)	Mexico	Blanco Cristilano 1	PR 76B Lote 10	8	32	47	59
3.	Gemiza 7523/2 (White)	Egypt	"	TL 76B Lote 149	11	31	42	53
4.	Across 7524 (Yellow)	Across Locations	Ant. x Ver. 181	TL 76B Lote 149	5	23	38	51
5.	Pantnagar	India	"	PR 76B Lote 76B	16	17	33	55
6.	Across 7425 (White)	Across Locations	(Mix. 1x Col.gpo.1)	PR 76B Lote 77	1	29	48	62
7.	Poza Rica 7526 (Yellow)	Mexico	Mezcla Amerilla	PR 76B Lote 23	7	20	41	64
8.	San Andres 7528/1 (Yellow)	El Salvador	Amerillo Dentado	PR 76B Lote 37	3	28	36	54
9.	Cotaxtla 7429 (White)	Mexico	Tuxpeno Caribe 2	TL 75B Lote 127	6	30	43	49
10.	Pichilingue 7429 (White)	Ecuador	"	PR 76B Lote 78	15	24	39	50
11.	Across 7429 (White)	Across Locations	"	PR 76B Lote 67	10	29	45	63
12.	Check 1: La Maquina 7422 (White)			PR 76B Lote 24	14	27	35	57
13.	Check 2: Tocumen 7428 (Yellow)			PR 76B Lote 20	12	22	46	61
14.	Check 3: Across 7443 (White)			TL 75B Lote 138	4	26	40	58
15.	Check 4: Suriname Caribbean mixed population (White)				13	21	34	52
16.	Check 5: Suriname Synthetic (Celos) (Yellow)				9	25	44	60

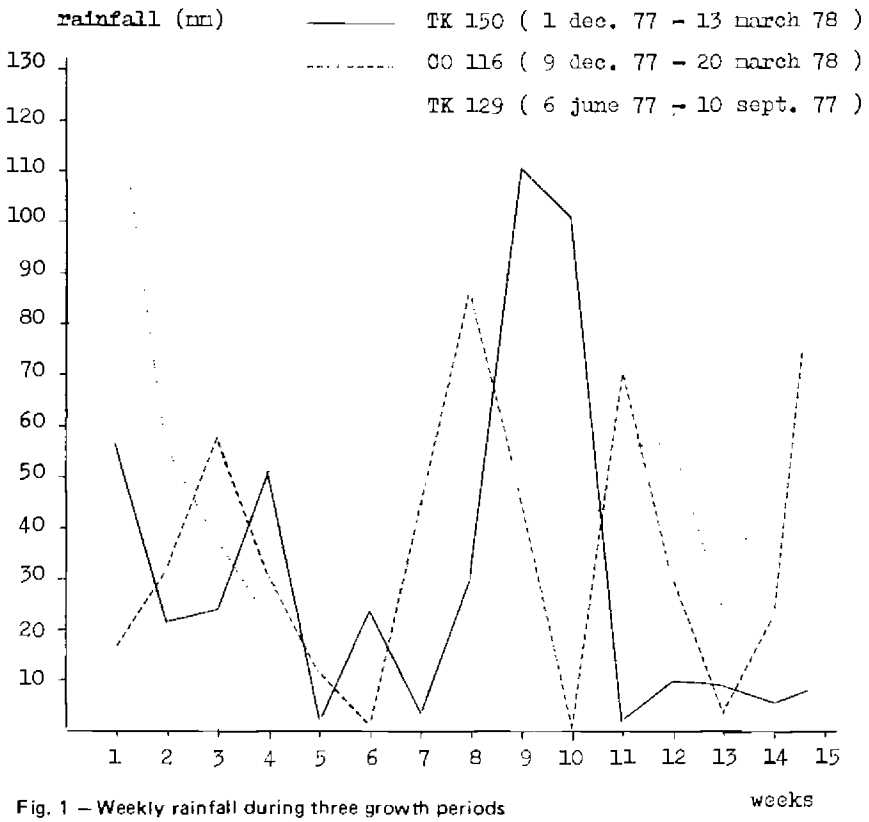

Fig. 1 – Weekly rainfall during three growth periods

RESULTS AND DISCUSSION

In this paper, the results of two simultaneous trials conducted at Tijgerkreek West and Coebiti (TK 150 and Co 116) are discussed. Sirnilar previous elite trial at Tijgerkreek West is also discussed in terms of grain yield while the yields in long and short rainy seasons are compared.

Plant height: plant height is one of the decisive factors determining the plants resistance to lodging. In recent years, by continuous selection of short statured plants and by crossing tall plants with short types, dwarf varieties have been developed with low ear placement and upright leaves. The plants new features make it possible to increase population density and so the grain yield. Elites used in the present trials were not of the dwarf type but short-statured with low ear placement and plant height compared to local varieties. At tijgerkreek West, elites had an average plant height of 215 cm whereas the local caribbean mixed population and synthetic had an average of 255 cm and 236 cm respectively. At Coebiti plant height was reduced to an average of 188 cm in elites and to 242 cm and 210 cm in local ones, Entries 15 and 16 respectively. At Coebiti, ear height was also reduced to 92 cm from 115 cm in elites and to 134 cm in local cultivars from an averaged 159 cm. The data on plant, ear height, number of leaves per plant and leaf length are presented in table 3.

Table 3. Growth of corn at two locations

Entry	Plant Height (cm)	Ear Height (cm)	No of leaves per plant	Leaf length (cm)	PLant height (cm)	Ear height (cm)	No of leaves per plant	Leaf length (cm)
1	214	117	13.0	94.4	191	90	13.6	87.2
2	209	101	12.3	94.3	173	77	11.6	89.4
3	212	105	12.5	96.2	188	85	12.2	87.7
4	205	112	12.7	94.7	176	89	13.4	87.3
5	214	118	12.9	98.4	181	89	13.2	86.8
6	203	101	12.2	98.2	177	81	12.7	89.0
7	202	104	12.3	94.3	178	82	12.9	90.0
8	216	111	12.8	96.6	207	110	13.7	94.0
9	210	110	12.7	99.8	182	86	12.7	90.3
10	213	117	13.2	99.3	173	88	13.5	91.1
11	211	109	12.3	99.8	179	87	12.9	89.5
12	227	121	13.4	97.7	199	99	13.9	89.8
13	235	136	13.0	99.2	209	113	14.0	95.3
14	251	148	13.5	99.7	219	117	14.8	92.5
15	255	167	13.9	105.8	242	142	14.7	96.7
16	236	151	13.8	98.2	210	125	14.9	90.5
Mean	219	120	12.9	97.9	193	98	13.4	90.4

From the above information it is obvious that considerable differences in plant and ear heights did exist not only between CIMMYT and local cultivars but also between the two experimental sites, the latter probably due to the nature of the soil and weather conditions during the growing season.

Maturity: Maturity as measured by counting days up to flowering (from planting) did not differ significantly between locations but differed with varieties. Elites matured a week earlier than local varieties. Elites took an average of 55 to 60 days to half-silk while the local ones took an average of 60 to 67 days. A significant negative correlation was found between plant height and maturity in both trials.

Correlation coefficient(r) values are presented in table 4.

Table 4. Correlation coefficients (r)

	TK 150	Co 116
Plant height and Leaf number	0.8762**	0.7734**
Plant height and grain yield	− 0.4716 NS	− 0.5575*
Leaf number and grain yield	− 0.5402*	− 0.6034**
Leaf number and days to half silk	0.8418**	0.6572**
Plant height and days to half silk	0.8114**	0.6722**

* ** significant at .05 and .01 percent level of significance, respectively.

Leaf number: Number of leaves per plant varied with the varieties and locations. At Coebiti, the elites produced an average of 14 leaves per plant and local ones, 15 leaves but at Tijgerkreek West the leaf number was lower, 13 in elites and 14 in local cultivars. In the previous season at Tijgerkreek West the number of leaves per plant in elites were from 12 to 14 and 16 in local varieties. It is known that leaf number is generally affected by environmental variables and even cultural practices. A significant correlation was found between leaf number, plant height and maturity.

Tall plants tend to have more leaves than short plants. Elites which were early maturing had fewer leaves than tall, late maturing local ones. The results agree with those of various investigators who concluded that a good relationship existed between number of leaves per plant height;

(Cross and Zuber, 1973); number of leaves per plant and maturity (Arnold, 1969; Chase and Nanda, 1965; Kuleshov, 1932). Leaf number was negatively correlated with grain yield. Short plants had better yields than tall varieties.

Leaf length was longer in all cultivars at Tijgerkreek West than at Coebiti and slightly longer in local varieties than in CIMMYT elites.

Ear characteristics: Number of ears per 100 plants and seed yield per ear were calculated. More number of ears per 100 plants (1.2 per plant) were noticed in local ones than in elites. Elites produced mostly one cob per plant. If there was a second one on the plant it was invariably very small. Cobs were comparatively smaller at Coebiti than those at Tijgerkreek West.

Most important of all, the cobs were poorly filled with grains and second in grain quality to that of Tijgerkreek West. Average cob length was found to be 18 cm at Tijgerkreek West and 15 cm at Coebiti. No significant varietal differences were found among the elites and only in local, Synthetic variety the cobs were slightly smaller (16 to 18 cm) than others.

Table 5. Ear and grain yields of corn at two locations

Entry	Tijgerkreek-West (TK 150)			Coebiti (Co 116)			TK 129 Previous trial
	No of cobs per 100 plants	Seed yield per ear (gms)	Grain yield per hectare (kg)	No of cobs per 100 plants	Seed yield per ear (gms)	Grain yield per hectare (kg)	Grain yield per hectare (kg)
1	101	148	6,182	100	93	3,721	6215
2	101	147	6,333	100	87	3,636	7254
3	100	153	6,576	98	86	3,472	7503
4	100	152	6,455	102	87	3,700	7163
5	103	154	6,909	99	90	3,585	6442
6	100	143	6,242	101	88	3,861	6366
7	101	147	6,394	100	89	3,733	4772
8	100	146	6,272	100	90	3,794	7136
9	102	168	7,424	102	88	3,664	6806
10	101	161	6,909	99	81	3,186	7821
11	101	159	6,969	100	87	3,669	7342
12	103	150	6,697	99	84	3,158	6081
13	100	154	6,727	101	84	3,412	7366
14	101	147	6,333	101	88	3,533	6103
15	106	151	5,182	99	76	2,930	6388
16	109	103	4,152	101	60	2,400	3985
Mean	102	149	6,360	100	85	3,466	6546

The seed yield per ear varied from 146 to 168 grammes in elites at Tijgerkreek West, compared to and 81 to 93 gms at Coebiti; and 151, 103 gms in local varieties 15 and 16 at TKW and 76 and 60 in local entries 15 and 16 respectively at Coebiti.

Grain yield: Data on grain and ear yields are presented in table 5 and fig 2. Grain yields were calculated at 14 percent mesture content. Data were statistically analysed and the analysis of variance showed significant differences between the varieties at both location at 0.01 percent level of significance. Grain yields varied with the season at TKW. Elites produced a calculated top yield of 7190 kilograms per hectare in the long rainy season (previous trial; TK 129) whereas the average grain yield of same elites was about 6360 in the short rainy season (present trial, TK 150).

Fig. 2. Grain yields from three elite trials (1977-78)

Yield differences of 200 to 1200 kg/ha were observed in varieties between the two seasons. In the long rainy season (636.9 mm rainfall) there was a better distribution of rainfall (fig 1) than in the short rainy season (471.1 mm) when there were three dry periods of a week during the 5th, 7th and 11th week after planting. At Coebiti there were two dry spells in the 6th and 10th week after planting and the plants showed symptoms of water stress by "wilting" due to the nature of the soil. So this variation in yields can presumably be due to the rainfall pattern and distribution. Grain yields of all the 16 varieties were drastically reduced at Coebiti by about ± 54% those at Tijgerkreek West-Average elite grain yield was 3600 kilograms per hectare. Besides the poor chemical nature of the soil, and low water holding capacity, dry periods and low rainfall were important factors which contributed to such low yields. At both sites,elites outyielded local varieties by about ± 1,000 kg per hectare. Local, Synthetic variety (Entry 16) produced lowest yields of 4,150, 4,152 and 2,400 at Tijgerkreek West and Coebiti, respectively.

Highest yielders differed at the two trial sites. Entry 9, Cotaxtla 7429 produced a top grain yield of 7,424 kilograms per hectare at TKW while entry 6, Across 7425 yielded 3,861 kilograms per hectare at Coebiti. In the previous season at Tijgerkreek West Entry 10, Pichilingue 7429 produced highest yield of 7,821 kilograms per hectare.

CONCLUSIONS

From the above results, it can be concluded that the elites produced superior yields compared to local varieties at both the experimental sites, but unfavourable soil and climatical conditions resulted in lower grain yields at Coebiti. Previously research workers already concluded that the short rainy season is not favourable for maize growing at Coebiti and grain yields were lower to those of Tijgerkreek West due to the erratic distribution of rainfall, dryness during critical stages (fig 1), poor chemical status and low water holding capacity of the soil. (Consen an Veltkamp, 1976).

Though elites proved to be better yielding compared to local varieties maize cultivation is less profitable at Coebiti than at Tijgerkreek West considering the application of high fertilizer levels transport costs etc.

At Tijgerkreek West, elites gave an outstanding performance and the best yielders should be planted on a large scale to confirm their stability for production and to observe their susceptibility to pests and diseases before releasing them to farmers.

REFERENCES

Arnold, C.Y, 1969. Inherited characteristics of sweet corn as they relate to the time required for development, J. Amer Soc. Hort. Sci 94: 112 – 115.

Bolton, A, 1967. Quoted from Fertilizer Guide 1970. Centre d' Etude de l'Azote.

Chase, S.S. and Nanda, D.K., 1965. Relation between leaf number and maturity in maize (zea mays) Amer. J. Bot 52; 628.

Consen, K and Veltkamp, H.J., 1976. Report no. 26, Agricultural Experiment Station, Parmaribo.

Cross, H.Z. and Zuber, M.S., 1973. Interrelationships among plant height, number of leaves and flowering dates in maize. Agr. J 65 no 1: 71 – 73.

Kuleshov, N.J., 1932. Behaviour of American corn strains and hybrids in USSR. J. Amer. Soc. Agron 24: 416 – 417.

Lata, G.S., 1978. "Maize cultivation in Suriname", Proc. CFCS Vol. XV : 119 - 126.

NAME OF PAPER: Performance of fourteen elites
(G.S. Lata)

Question by Abdul Wahab
Country: Jamaica

QUESTION: As grain yields seem not to differ dramatically between (some of the) CIMMYT elite varieties what other criteria will be started to make a final selection?
Some suggestion should be: *Pucinia*-resistance *(Heliothis, Spodoptera, Diatraea* etc.) protein contnt and composition. Uniformity (especially ripening time).
Did you do directed observations for any of these characters?

ANSWER: Besides grain yields, color of the grains, maturity, resistance to major pests and diseases such as *Spodoptera frugiperda, Heliothis zea* and *Helminthosporium maydis*, respectively, are considered.
We did have observation on rate of infection of *Helminthosporium maydis* but could not find great differences between the varieties.

Question by: R. Segeren – v.d. Oever
Country: Suriname

QUESTION: Did you observe or do you expect birds are more becoming a problem in these elite varieties because of their longer cobs and because of cobs are filled to the end. Are the cobs completely covered by the husks?

ANSWER: The cobs are not completely covered with husks.
The protruded ends attract birds.
I don't see an immediate solution for this problem, however.