Table 3. Effect of N sidedress on yield and growth of southernpea.

N sidedress	Plant fresh wt (kg/m²)	Shelled pea yield (MT/ha)	Shelled pea yield (g/plant)
None	16a[y]	2.2b	18b
34 kg/ha	17a	2.5a	19a

[y]Mean separation, within columns, by Duncan's multiple range test, 5% level.

Table 4. Effect of tillage method on nutrient concn and uptake by southernpea.

Nutrient	Concn[z] (dry wt)			Uptake (kg/ha)		
	Disk	Deep Turn	Rip-bed	Disk	Deep Turn	Rip-bed
N	2.24b[y]	2.33a	2.31a	71b	100a	93a
P	.28a	.31a	.27a	8.8b	13.2a	11.1ab
K	2.13b	2.41a	2.52a	63b	102a	100a
Ca	.67b	.78a	.67b	21c	34a	27b
Mg	.34a	.31a	.32a	11a	13a	14a
Mn	74a	63a	62a	.24a	.27a	.24a
Fe	142a	126a	146a	.45b	.55a	.57a
B	22a	22a	24a	.07b	.10a	.10a
Cu	7a	9a	9a	.02b	.04a	.04a
Zn	.25a	21b	20b	.08a	.08a	.08a

[z]Concn as % for N, P, K, Ca, Mg; as ppm for Mn, Fe, B, Cu, Zn based on dry wt.

[y]Mean separation, between tillage methods, by Duncan's multiple range test, 5% level.

pea yield of the disk treatment was increased 21% by N sidedress while yield of the deep turn and rip-bed treatments were increased 7% and 3% by N sidedress. Plant fresh wt tended to be greater with N sidedress. Plant size response to N sidedress with the tillage systems was similar to yield response. Plant stand, seed per pod, seed wt, and no. of pods per plant were not significantly affected by N sidedress; however, seed wt and seed per pod tended to be greater with N sidedress.

N and K concn in plants of the deep turn and rip-bed treatments was greater than plants from the disk treatment while Zn concn of plants from the disk treatment was greater (Table 4). Both the disk and rip-bed tillage methods resulted in lower Ca concn than the deep turn method. Nutrient use efficiency, as indicated by nutrient uptake, includes both nutrient concn and dry matter production. Total nutrient use efficiency by plants of the deep turn and the rip-bed tillage methods was 50 and 40% greater than the disk treatment. The deep turn treatment tended to result in a greater nutrient uptake than the rip-bed system, although the differences were not significant. The root distribution patterns developed with these two tillage methods indicated that nutrient use efficiency of mobile nutrients, applied as a dry broadcast or through an irrigation system, would be greater with the deep turn tillage method.

We have shown that southernpea, a vegetable crop usually considered to have good root penetration capability and to be relatively drought resistant, responds to tillage methods which produce a large volume of low strength soil. Penetrometer data indicate that the volume of low strength (< 1000 kPa) soil per m of row was about 0.15 m^3 with disk, 0.30 m^3 with rip-bed, and 0.40 m^3 with deep turn tillage methods when implement traffic is restricted to the wheel tracks produced by the planting operations. Differences in volume of low strength soil are reflected in root growth, plant growth, yield and nutrient use efficiency.

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A Field Study of Color Intensity in Freezing Peas

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Additional index words: irrigation, light, *Pisum sativum*

Abstract. **Substandard color was encountered in experimental frozen samples of pea (*Pisum sativum* L.) produced in the San Luis Valley, Colorado in 1973 and 1974. Light green and blond peas were mixed with normal dark peas rendering the samples unacceptable. Peas planted in April, 1975 had satisfactory color regardless or irrigation schedule or tenderometer reading at harvest. May-planted peas generally had inferior color and this was aggravated by frequent irrigations and over maturity.**

The public expects uniform-green frozen peas. Occasionally a package contains a few peas which are light green or yellow. The best way to eliminate off-colored peas is to prevent their development.

Wrapping developing pea pods in aluminum foil has been found to reduce the green color of peas (1, 7). Shading plants reduced pea color to a lesser extent (7), but irrigation frequency, seed source, seeding rate, location, and levels of plant nutrition did not influence pea color (2, 3, 4). Pea processors agree that light colored peas were caused by light deficiency (7). Light green peas were observed in test plots in the San Luis Valley in 1973 (5) and further testing in 1974 (6) associated this problem with late harvesting, high seeding rates, high nitrogen, high yields, high tenderometer readings, and lower (early set) pots on the vines.

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In 1975 the effect of planting date, irrigation frequency and time of harvest on color of freezing peas 'Darkskin Perfection' was evaluated. The peas were grown in 8–9×10 m plots with odd numbered plots being irrigated every week and even numbered plots irrigated every 2 weeks. Half of each plot was drilled on April 25 while the other half was drilled on May 22. A 1×1 m sample was harvested from each plot on 3 successive weeks. The "week before" harvest was made a week before the treatment would normally be harvested, and these peas were shelled, sampled on the tenderometer, blanched and frozen. The following week the "prime" harvest was made, and the third week the "week after" harvest was made, with samples of each harvest being frozen.

At the end of the season the samples were defrosted in white enamel trays and arranged in 5 rows according to color. Those having excellent color were rated 5, good color 4, fair color 3, substandard color 2, and discard (poor) color 1.

Twenty of the 48 samples had excellent color, a tenderometer reading of 86 and a yield of 1350 kg/ha, while discard peas had a tenderometer reading of 134 and a yield of 9440 kg/ha (Table 1). High yields and possibly high tenderometer readings appear associated with poor color.

April planted peas had better color, lower tenderometer readings and only half the yield of the May planted peas (Table 2).

Color becomes less acceptable with maturity as tenderometer and yield increase (Table 3). Of the 3 harvests, the second or "prime" harvest is preferred because the color is good, the peas are still tender (110 TR), and the yield is acceptable (4390 kg/ha).

April planted peas produced "good" colored peas on the third weekly harvest when the tenderometer registered 134 and a yield of 4800 kg/ha, while May planted peas never had "good" color even when harvested at 89 tenderometer (Table 4). Since a processor would not want to freeze peas having only a "fair" color, he would not contract for May planted peas in the San Luis Valley.

Table 1. Relationship of tenderometer, yield and color of freezing peas grown in the San Luis Valley of Colorado, 1975.

Color	Tenderometer	Yield (kg/ha)	No. of samples
5.0 (excel)	86 a^z	1350 a	20
4.0 - 4.9 (good)	137 b	4600 b	8
3.0 - 3.9 (fair)	126 b	4780 b	14
2.0 - 2.9 (sub-std)	130 b	6760 c	5
1.0 - 1.9 (discard)	134 b	9440 c	1

^{z}Mean separation within columns by Duncan's multiple range test, 5% level.

Table 2. Summary of results from April and May pea plantings. San Luis Valley of Colorado, 1975.

Planting date	Color	Tenderometer	Yield (kg/ha)	Sample size
April 25	4.7 a (good)	99 a^z	2600 a	24
May 22	3.0 b (fair)	126 b	5950 b	24

^{z}Mean separation within columns by Duncan's multiple range test, 5% level.

Table 3. The effect of weekly harvests on color, tenderometer reading, and yield of freezing peas. San Luis Valley of Colorado, 1975.

Harvest week	Color	Tenderometer	Yield (kg/ha)	Samples
Week before	4.4 a (good)	79 a	2510 a	16
Prime	4.0 b (good)	110 b	4390 b	16
Week after	3.2 c (fair)	148 c	5910 c	16

^{z}Mean separation within columns by Duncan's multiple range test, 5% level.

Table 4. The effect of planting date and time of harvest on peas for freezing, San Luis Valley of Colorado, 1975.

Planting date	Harvest week	Color	Tenderometer	Yield (kg/ha)	Samples
April 25	Week before	5.0 a^z (excel)	69 d	780 a	8
	Prime	5.0 a (excel)	93 c	2210 a	8
	Week after	4.0 b (good)	134 b	4800 b	8
May 22	Week before	3.8 b (fair)	89 c	4230 b	8
	Prime	3.0 c (fair)	126 b	6580 c	8
	Week after	2.4 d (sub-std)	163 a	7030 d	8

^{z}Mean separation within columns by Duncan's multiple range test, 5% level.

Color of peas from weekly irrigated plots was only "fair" while color of the bi-weekly plots was "good" (Table 5). Yields were lower and tenderometer readings were higher on the bi-weekly irrigated plots. The difference in tenderometer readings can be explained on the basis of physiological age. While both weekly and bi-weekly irrigated plots were planted on the same dates, the bi-weekly irrigated peas were water stressed and matured sooner. The higher tenderometer reading is an indication of this advanced maturity (Table 5).

The effects of bi-weekly and weekly irrigations on color can be nullified or accentuated by planting date. Irrigation frequency had no effect on pea color with April-planted peas, but the May-planted peas receiving bi-weekly irrigations had better color than those irrigated weekly (Table 6).

A processor would find all peas produced from the April planting acceptable on the basis of color although

Table 5. Effect of irrigation frequency on freezing peas. San Luis Valley of Colorado, 1975.

Irrigation	Color	Tenderometer	Yield (kg/ha)	Samples
Weekly	3.6 a^z (fair)	97 a	5010 a	24
Biweekly	4.1 b (good)	128 b	3530 b	24

^{z}Mean separation within columns by Duncan's multiple range test, 5% level.

Table 6. Effect of irrigation frequency and planting date on performance of freezing peas, San Luis Valley of Colorado, 1975.

Planting date	Irrigation	Color	Tenderometer	Yield (kg/ha)	Samples
April 25	Weekly	4.8 a^z (good)	92 a	3090 a	12
	Biweekly	4.6 a (good)	107 a	2100 a	12
May 22	Weekly	2.5 b (sub-std)	102 a	6940 a	12
	Biweekly	3.6 c (fair)	149 b	4960 b	12

^{z}Mean separation within columns by Duncan's multiple range test, 5% level.

Table 7. Influence of irrigation frequency, time of planting and time of harvest on color (C), tenderometer (T) and yield (Y, kg/ha) of freezing peas. San Luis Valley of Colorado, 1975.

	Time of harvest								
	Week before			Prime			Week after		
Time of planting	C[z]	T	Y	C	T	Y	C	T	Y
April 25									
Weekly irr.	5.0a[y]	67e	660e	5.0a	93d	2580cd	4.3b	115c	6050bc
Biweekly irr.	5.0a	71e	910de	5.0a	95d	1840de	3.8bc	152b	3550c
May 22									
Weekly irr.	3.0cd	76e	4170c	2.5d	103d	7240b	2.0de	128c	9390a
Biweekly irr.	4.5ab	102d	4300c	3.5c	149b	5910bc	2.8	197a	4660c

[z]Color (C) 5, excellent color; 4, good color; 3 fair color, 2, substandard.

[y]Mean separation for color (C), tenderometer (T) and yield (Y) means within columns by Duncan's multiple range test, 5% level.

he would reject the lot with 152 tenderometer for being too hard (Table 7). From the May planting only those peas harvested a "week before" prime maturity could be acceptable.

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Two Centrifuge Techniques for Estimating the Carbohydrate and Pigment Status in 6 Genotypes of Corn[1]

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Abstract. **Two centrifuge techniques were used to estimate some characteristics of kernels of maize (*Zea mays* L.) with the genes *Su, su, su-IL677a, ae du wx, bt2,* and *sh2.* The first technique produced 4 recognizable layers which could be associated with stage of maturity; sugar, water soluble polysaccharides, and starch; and the production of smooth, wrinkled, and shrunken seed. The 2nd technique resulted in the extraction of pigments. Spectrographic analyses suggested that differences in visual perception at different stages of maturity or among genotypes were associated with differences in concentration rather than types of pigments present.**

I have previously described (1) a centrifuge technique for estimating the maturity of sweet corn for cultivars possessing the *su* gene. This paper extends this technique to other genotypes that affect the carbohydrate composition of the kernels, plus the use of a modification which permits the extraction of yellow pigments.

The cultivars used were OH43, a *Su* inbred; Iochief, a *su* hybrid; *su-677a,* an Illinois inbred; an Iochief conversion with *ae du wx* substituted for *su;* an inbred of OH43 with *bt2* substituted for *Su;* and Illini Xtra Sweet, a *sh2* hybrid. Tassels and silks were bagged to insure selfing or sibbing. At 3 dates after polination, 6 randomly selected ears were harvested for analysis. The interval between pollination and harvest is reported in standard days after pollination (SDAP). Values for SDAP/day were calculated from mean daily temp using a modification of the temp-rate relationship reported (2,7) for the period from silk to harvest. In this system the rate is 0 at 0°C and increases in a linear fashion through a value of 1 at 21°. The daily values were accumulated between pollination and harvest.

The removal of the sample from the cob was the same in both techniques. Essentially, the pericarp was left on the cob and the sample consisted of endosperm and embryo tissue. For details see (1). In technique 1, a 50 g sample was blended with 50 ml of 80% ETOH for 4 min at an Osterizer setting of chop. The blended sample was centrifuged for 10 min at 3000 rpm in graduated 15 ml tubes. Estimates were made of the magnitude of the distinguishable layers. Samples from individual layers were treated with an I_2-KI solution to determine the presence of polysaccharides. Refractometer readings were made on the liquid layer. In technique 2, a 10 g sample was blended with 100 ml of 95% ETOH for 4 min at an Osterizer setting of liquid or frappe. The blended sample was then centrifuged for 5 min at 3000 rpm. Spectrographic analysis was run on the supernatant liquid. Percent H_2O was determined from separate samples which were weighed and reweighed after 24 hr in a forced draft oven at 60°C and ½ hr in a desiccator.

The first consideration deals with the feasibility of using % kernel moisture and % total white as indicies of kernel maturation As shown in Table 1,

Table 1. Percent kernel moisture and % total white associated with SDAP.

Genotype	Harvest no.	SDAP at harvest	% kernel H_2O	% total white
Su	1	20	71	55
	2	26	58	72
	3	33	y	y
	x-z		2.2	2.8
su	1	20	71	69
	2	26	62	79
	3	33	59	y
	x-z		1.5	1.7
ae du wx	1	20	79	44
	2	26	74	67
	3	33	71	81
	x-z		0.6	2.8
677a	1	18	76	43
	2	23	70	67
	3	29	66	76
	x-z		0.9	3.0
bt2	1	19	77	40
	2	26	71	47
	3	32	y	y
	x-z		0.8	1.0
sh2	1	19	79	32
	2	25	78	40
	3	33	76	48
	x-z		0.2	1.1

[z]The mean change per standard day over the period observed.

[y]Samples too advanced in maturity to give reliable readings.

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