

# Yield of Broccoli Strains

## investigations on the influence of summer planting dates on yield of four strains of broccoli

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**Broccoli quality** is best if the flower-bud clusters reach market maturity in cool weather, although the early growth may take place at high temperatures.

To harvest broccoli in the Sacramento Valley in the early fall, the very early or early strains are preferable and should be seeded in July. For late fall and winter harvest, the midseason strains are best and could be seeded until early in August.

September 1st is too late a date for the direct seeding of broccoli in this area.

It would be possible to plant broccoli in the Sacramento Valley at any time during the summer, fall and early winter months if the yields from all such plantings were satisfactory.

Preliminary experiments showed that fall and early winter planting dates gave very poor yields due to the effect of the cold weather in checking the growth of the plants.

The problems involved in 1945-46 and 1946-47 experiments in broccoli production in the Sacramento Valley were the selection of suitable strains and planting periods for those strains in order to provide a sequence of supply over a long period.

The experiments were laid out in a split plot Latin square design, with three planting dates, each replicated three times.

DeCicco, Group I, Freezers', Medium, Late and Morse Early are standard strains. Two Early and two Medium strains were used in this experiment. The Freezers' strain was used in 1945-46 but not in 1946-47. The strains were arbitrarily separated into very early, early, midseason, and late groups. The seed trade usually lists them as Early, Medium, and Late strains but such a classification is not adequate.

The seed was drilled in rows on 40-inch centers and the plants thinned to 18 inches in the row. This thinning was done in two steps in order to have as uniform plants as possible. In 1945-46 there were 20 plants in each replicate. In 1946-47 twice that many were used. The broccoli was grown on a highly productive Yolo silt loam. No fertilizer was used in 1945-46 but the 1946-47 planting received 100 pounds of nitrate of soda per acre as a side-dressing on September 18, 1946.

The centers and shoots were cut as the

buds reached maturity, the larger leaves were removed and the stems cut to an eight-inch length before weighing. Both lateral and sub-lateral shoots were harvested as long as the diameter of the stems was about one-half inch or more, and that of the bud clusters one inch or more. This smallest size would be satisfactory for freezing or for bunching for California markets but would not do for shipment to eastern markets. Harvests were made at three- to 10-day intervals depending on the weather and rate of development of the crop. By mid-March or earlier the size of the product on all plots was such as to be not worth harvesting.

In 1945-46 the side shoot yields of Freezers', the Mediums, and Group I were all comparable. However in 1946-47 the Mediums gave the greatest total yield of side shoots. The weight of side shoots per plant decreased rapidly as the planting date was delayed from July 1st to September 1st. This is the result of a reaction to climatic conditions and also to the longer harvesting period from the July 1st seeding.

While the method of analysis used does not permit comparison of the performance of the strains within any one planting date, it appears that the Mediums out yielded the others at the August 1st and September 1st planting dates especially in 1946-47.

In 1945-46, the late strain gave the greatest average total yield for the season while DeCicco was the lowest yielding strain. The high total yield of the Late strain was due to the large size of the center head with its heavy stem as compared to these characteristics in all the other strains. There were no differences between the remainder of the strains. In the following year also the quicker maturing the strain the lighter was the total yield.

There was a consistent decline in the total yield as the planting was delayed later in the season. The plant growth also decreased. Observations indicated that the plants started July 1st made half again as much plant growth as those started August 1st and the latter about 50% more than those planted on September 1st.

The very early and early strains were much more strikingly reduced in their

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The Average Total Yield per Plant as Affected by Strain and Date of Seeding

Strain	1945-1946				1946-1947				
	July 1	Aug. 1	Sept. 1	Ave.	July 1	Aug. 1	Sept. 1	Ave.	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
<b>Very Early</b>									
Group I . . . . .	1.33	1.04	.58	.98	1.45	.85	.58	.96	
DeCicco . . . . .	1.19	.80	.45	.81	1.57	.90	.58	1.02	
Freezers' . . . . .	1.44	1.11	.54	1.03					
<b>Early</b>									
Morse Early (C-0162) . .	1.26	1.03	.51	.93	1.58	1.12	.70	1.13	
Morse Early (C-5126) . .	1.40	1.02	.48	.96	1.61	1.28	.68	1.19	
<b>Midseason</b>									
Medium (Asgrow) . . . .	1.30	1.07	.71	1.03	1.60	1.48	.69	1.26	
Medium (Morse) . . . . .	1.27	1.06	.70	1.01	1.62	1.47	.77	1.29	
<b>Late</b>									
Late . . . . .	1.36	1.55	.89	1.27	1.96	1.46	.61	1.34	
Average at each seeding date . . . . .	1.32	1.08	.61		1.62	1.22	.66		
					Odds of		Odds of		
Difference required between . . . . .					19:1	99:1	19:1	99:1	
(a) seeding date averages . . . . .					.19	.43	.09	.21	
(b) strain averages . . . . .					.13	.17	.16	.21	

## FUNGI

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break down within a couple of years and snapdragons became as badly infected as before.

Investigation of this apparent breakdown of resistance revealed the presence of more than one biologic race of the rust fungus in the state.

The temporary nature of the resistance in the cantaloupes and snapdragons apparently was due not to a genetic breakdown in the host plants but rather to genetic changes in their respective pathogens.

### Fungi Readily Mutable

Fungi differ from higher plants again in that during the greater part of their existence they are haploid—having a definite number of single chromosomes, where each higher plant has a definite number of pairs of chromosomes which are the structures in which the genes are located.

Since each fungus nucleus has only one set of single chromosomes there can be no dominant or recessive genes and all are immediately effective. This haploid condition also makes the fungi much more responsive to environmental changes so that they apparently mutate much more frequently than do the higher plants. It is this mutability that enables the pathogenic fungi to adjust themselves to new or different environments and to overcome or by-pass such obstructions as resistant genes in their favorite host plant.

In addition to the variants arising by direct mutation there are those that arise by genetic segregation. There are in many fungi natural mechanisms that insure cross fertilization and greatly increased variability and therefore greatly increased adjustability.

The accompanying illustration—page 4—shows 14 cultures of a fungus that is pathogenic on members of the squash family.

The two at the upper left are the parents, female and male, and the other 12 are some of the progeny from a single mating. There are striking physical and cultural differences between parents and offspring and between the individuals. There is a color range from deep brown to white, with shades of blue, green and yellow in between.

Aside from these observable differences there are also differences in pathogenicity or virulence.

Each of the two parents is moderately pathogenic. With either one of them present it is possible to grow plants of the squash family to maturity. With the progeny, it is a quite different story. If the specimens shown in the photo are

numbered from one—top left—to 14, then numbers three, 10 and 13 are much like the parents in their pathogenicity. Numbers six, nine and 11 are nonpathogenic but numbers four, five, seven, eight, 12 and 14 are so highly pathogenic and virulent that they will kill young squash plants in less than 10 days.

It is evident that effective use of genetic means of combating plant diseases must recognize the existence and the whereabouts of pathogenic fungi—their behavior under various conditions, their range of variability and the significance of this variability in their inheritance.

To this end the College of Agriculture is conducting continuous and intensive investigations of plant pathogenic fungi.

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## HYBRID CARROT

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The balance of the plants—of the 67 planted—either had not flowered when the last notes were taken or were lost before classification.

No difficulty was encountered in distinguishing between male-sterile and normal plants. The abnormal specimens appeared like the parental male-sterile plant found in the winter 1945-46 greenhouse planting. The mode of inheritance of the male-sterile character is unknown, because so far only a relatively small segregating population has been studied. Further breeding tests will be required before a genetical explanation can be proposed.

To determine whether male-sterile plants produce any self-fertile pollen, umbels of four segregants—apparent male-sterile plants—were caged with blowflies.

Three of these plants set a few seeds. If enough plants can be grown from these seeds, proof should be obtained as to whether these were really selfed seeds or were cross-pollinated from normal plants by thrips, ants, or some other very small insects that penetrated the fine-mesh cloth cage covering. Umbels were not allowed to touch the cloth, thus eliminating the possibility of insects outside the cages pollinating enclosed flowers pressed against the inside of the cloth. Isolated plantings of single male-sterile plants and other plantings with several male-sterile plants would give further information on the possibility of viable pollen production.

At the time the  $F_1$  population involving male sterility was being classified, several dozen plants in other carrot-breeding lines were examined for flowering habit. Four plants were found to possess varying degrees of apparent male sterility. Each plant produced some exerted stamens, but the number was only a small

percentage of those which would normally be exhibited. Two of the specimens shed pollen, the viability of which was not determined, but no pollen production by the remaining two plants was observed. All four set an abundance of open-pollinated seed. This partial male sterility was not encountered in classifying the  $F_1$  population which segregated for the male-sterile character.

The mode of inheritance in the carrot of the male-sterile character, for which segregation data were presented, and the partially male-sterile types with which no controlled crosses were made will not be known until additional breeding tests are completed.

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*The above article is based on work conducted while Dr. Welch was Associate Horticulturist, U. S. Regional Vegetable Breeding Laboratory, U.S.D.A. Charleston, South Carolina. Investigations are being continued at the University of California under Research Project No. 906.*

## BROCCOLI

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yield, especially of side shoots, by the August 1st and September 1st plantings compared to that of July 1st than were the midseason strains. The effect of planting dates on decreased side-shoot production in the Late strain was not very great in 1945-46 but more pronounced than in any other strain in 1946-47.

It was apparent that the strains used in this work fall into the four groups suggested. There is a fairly close similarity between the two years in the dates by which any given strain has reached the stage at which 75% of the center heads had been harvested. When the planting was delayed until September 1st, there was much less difference between the dates at which the various strains reached this stage of harvest than was the case in the July 1st planting. The cool fall weather tends to obliterate the differences between strains.

Side-shoot harvesting started soon after the first center heads were cut. The dates at which the first marketable heads were found did not differ greatly between the very early and early strains. The tendency for the very early strains to cease production of harvestable material sooner than the others was clearly shown in the July 1st and August 1st plantings.

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