Plant Variations in Asparagus Lines

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CONSIDERABLE VARIATION has been shown to exist among plants of commercial asparagus. The greatest differences have been found between staminate and pistillate plants, but variability within the sexes has also been reported. This study was undertaken to determine the amount of variation within five California lines grown in southern California, and to identify superior plants for use as breeding and planting stock.

Five lines

Five asparagus lines from G. C. Hanna's University of California vegetable crops breeding program formed the genetic material for the study: line A—the progeny of a cross between N.J. 28, a line selected by Dr. J. H. Ellison at Rutgers University, and D37, a large staminate plant maintained at Davis, California; line B—500W; line C—309; line D—711; and Line E—an open pollinated fusarium wilt tolerant line developed from selected plants of line 711 and 873.

Ten crowns from each line were randomly selected from a three-year-old variety planting and each crown was divided into 10 segments. The segments were ranked from one to 10 by size and each size group was designated as a replication. The odd numbered groups were planted at Riverside and the even numbered groups were planted at the Antelope Valley Field Station, Lancaster. A completely randomized plot design with forty-inch spacing between rows and within rows was used at each location. Unfortunately, soil and weather conditions were not favorable at the Lancaster location and this planting was not used for data collections.

TABLE 1. THE RANGE OF VARIATION FOR VARIOUS PLANT CHARACTERISTICS OBTAINED FROM AN ASPARAGUS POPULATION OF 250 PLANTS.*

	1966		1967	
	RANK			
	High	Low	High	Low
1. Avg. no. days to first spear	39	57	15	50
2. Avg. no. days to harvest first 8 spears	41	70	32	74
3. Avg. wt. of fiirst 8 spears (gms)	49	18	45	16
4. Avg. dia. of first 8 spears (cms)	2.45	1.37	2.44	1.33
5. Avg. no. spears produced to May 20	25	10	26	6
6. Avg. no. stalks (fern) on Nov. 14	37	6	36	7
7. Avg. wt. of fern on Dec. 21 (gms)	1050	142	–	–
8. Avg. size of crown in the fall (dia. cms)	29.90	12.63	–	–

* Population was made up of 5 segments per crown from 10 plants from 5 varieties. A few segments failed to survive or were discarded because of low vigor during the test period.

The following data were collected at Riverside (see tables):

1. Number of days after February 1 to appearance of first spear in 1965, 1966, and 1967.
2. Average number of days to harvest the first eight spears in 1966 and 1967. February 1 was considered as the first day.
3. Average weight of first eight spears in gms in 1966 and 1967.
4. Average diameter of first eight spears in cms in 1965, 1966, and 1967.
5. Number of spears produced to May 20 of 1965 and 1966.
6. Number of stalks on November 14 of 1965 and 1966.
7. Weight of fern in gms on December 21, 1966.
8. Crown size in the fall of 1965 and 1966. This figure comes from the diameter in cms of a circle whose circumference is equal to the length of a string required to enclose all stalks of a measured crown.

Significant differences

Significant differences were found among clones, varieties, clones in varieties, and males in varieties for each character studied. The differences among females in varieties were significant for all characters except number of stalks in the fall and fall crown size. The comparison of males with females in varieties did not show a significant difference in the average number of days to the harvest of the first eight spears, nor in the fall fern weight. Most of the interactions with years were significant for each character, except fall crown size and average spear weight. The general lack of interaction with years for these two characters indicates that clones could be evaluated for the characters in a single year, provided the number of clones tested and replications used were large enough to provide a sufficient allowance for testing differences.

For each of the plant characteristics studied, the variability among the asparagus clones was large. A comparison of the relative size of clones in variety-mean-squares to error-mean-squares indicated that a large proportion of the variation among clones was genetic. The range in variability between a superior plant and an inferior plant, for each category studied, is shown in table 1. The similarity in results obtained in 1966 and 1967 for plant characters 3, 4, 5 and 6 suggests that these plant characters are not influenced as readily by the prevailing climatic conditions as were characters

TABLE 2. AVERAGE PERFORMANCE OF MALE AND FEMALE CLONES FROM FOUR ASPARAGUS LINES*

Character	LINE B			LINE C			LINE D			LINE E		
	C	M	F	C	M	F	C	M	F	C	M	F
Days to first spear 1965–66–67	37.15	36.25	37.91	36.79	36.59	37.15	33.38	33.12	33.78	32.80	36.70	30.30
Avg days to harvest of 1st 8 spears 1966–67	56.21	54.85	57.35	54.82	53.41	57.38	50.86	51.50	49.88	50.37	52.83	48.76
Avg. wt. of 8 spears (gms) 1966–67	30.13	27.46	32.38	28.17	25.84	32.39	32.65	30.15	36.54	29.78	28.85	30.38
Avg. dia. of 8 spears (cms) 1965–66–67	1.70	1.57	1.81	1.66	1.58	1.80	1.82	1.73	1.96	1.74	1.67	1.79
No. of spears to May 20, 1965–66	8.59	8.81	8.39	10.57	11.52	8.84	12.20	11.21	13.72	11.08	12.11	10.41
No. of stalks in fall of 1965–66	11.07	11.34	10.84	15.83	18.03	11.84	16.34	14.88	18.61	15.88	19.67	13.45
Fern wt. (gms) 1966	243.31	268.11	222.42	339.22	336.88	343.46	516.40	479.01	574.58	494.83	406.12	551.86
Fall crown size (dia. cms) 1965–66	17.88	18.05	17.74	19.96	20.75	18.52	22.17	21.01	23.99	22.04	24.72	20.32

* Line A—the 10 crowns selected at random out of a group of male plants.

1 and 2. Earliness of production, as expressed by the appearance of the first spear (character 1) and production of the first eight spears (character 2), was strongly influenced by climatic conditions.

There appeared to be no difference in males and females in regard to earliness of production, although all other plant characteristics studied showed sex differences (table 2). However, these differences were not consistent in all varieties in all cases. For example, the males produced more spears in all varieties except variety 711. Also, the female plants produced heavier spears in each variety, but the difference between males and females was not consistent from variety to variety.

The total yield in number of spears harvested in 1967 for the highest yielding plant, the lowest yielding plant, and the varietal average for the 10 plant populations, are given in table 3. Also listed is the highest yielding clone and the lowest yielding clone within each variety. A comparison between the highest yielding plant and the varietal mean indicates that each variety possesses plants of superior production potential. The comparison between the mathematical mean calculated for the high and low yielding plants, and the varietal mean, suggests that fewer plants are high yielding than are low yielding. Considerable progress could be made in increasing asparagus yields by the elimination of the low yielding plants.

TABLE 3. VARIATION IN TOTAL YIELD FOR FIVE ASPARAGUS VARIETIES.*

Varieties	Avg. for variety	Range (plants)†		Range (segments)‡	
		High	Low	High	Low
Line A NJ28xD37	11.36	16.80	6.40	23	3
Line B 500W	9.88	20.00	6.20	25	3
Line C 309	10.89	17.40	6.60	24	3
Line D 711	14.68	26.20	7.20	39	1
Line E X	12.73	23.80	7.20	33	4

* Number of spears produced in 1967
† 10 plant population
‡ 50 segment population

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AIR POLLUTION and agriculture TODAY

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Agriculture still suffers huge financial losses each year from air pollution, but is now itself being examined with increasing vigilance as a source of pollution. Controlled fire has always been used by farmers for the preservation of food, for the destruction of pests and diseases, and for the disposal of wastes. Disposal of wastes—including straw, stubble, tree prunings, dead trees, and brush clearing on rangeland—produces smoke, odors, dust and air-borne particulate matter that is increasingly objectionable (but not necessarily harmful) to city dwellers as they continue to move out into rural areas. On the other hand, people-produced damage to farm crops from photo-chemical pollutants (resulting mostly from automobile exhaust) often occurs in the absence of analytical instruments that show first signs of air pollution. It is therefore important that there be continued surveillance of air pollution damage to agriculture, as well as measurement of amount and effects of agriculturally-produced pollution. This article discusses legislation, regulations and control aspects of the air pollution problem on a statewide basis, and offers a course of action for the future.

MANY OF THE normally accepted practices of agricultural husbandry in the past, although contributing comparatively little to local air pollution, have now become objectionable sociological problems. The greater congestion of people on formerly open land is the major reason for the increased emphasis on the problems of agricultural operations.

Enabling legislation

Legislative attempts at controlling air pollution in California began with passage of the 1947 enabling legislation which provided authority to county boards of supervisors to establish a county air pollution control district. County air pollution control districts have not had the power to control agricultural burning. However, some single-county districts have prescribed certain limited conditions under which such burning may be done.

Formation of the San Francisco Bay Area Air Pollution Control District by special action of the California legislature in 1955 provided a special district to control and suppress air pollution in that area. This multi-county district consists of six counties in the San Francisco area. Three additional counties may join at any time, upon appropriate action of their boards of supervisors. Open burning is prohibited by regulations of this District. Farmers in the Bay Area District operated until recently on a temporary exemption from this rule. However, orchardists in the counties of the Bay Area Air Pollution Control District now operate under a permit system. Permission to burn is granted only during a specified period of the year. Permission depends on meteorological conditions, time of day, wind velocity and direction, and moisture content of prunings. These restrictions were imposed even though nearly 75 per cent of the agricultural wastes are burned between November and April, when San Francisco Bay Area photochemical pollutant levels are significantly lower.