

## Research Note

### RESPONSE OF CABBAGE IN THE MOUNTAINOUS AND COASTAL AREAS OF PUERTO RICO<sup>1</sup>

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In Puerto Rico, cabbage (*Brassica oleracea* var *capitata*) production depends upon imported hybrid cultivars. For cultivar recommendation, the local Agricultural Experiment Station has traditionally evaluated cultivars in the coastal valleys<sup>6</sup>. Recommendations for cultivar use, however, may be extended to the central mountainous region despite the fact that there are notable differences in the management of cabbage, and differences in ecological conditions of these two production areas. In the coastal valleys drip irrigation, plastic mulch and fertigation are standard. Conversely, in the central mountainous region, production is usually under rain fed conditions, and hand hoeing is used for weed control. The objectives of this study were to evaluate the response of commercially available hybrids to the ecological conditions and management practices for cabbage in the two areas, and to determine whether testing for cultivar recommendation must be performed within the production area.

The Agricultural Experiment Station farms at Corozal and at Juana Díaz were chosen as representatives of the central mountainous region and the southern valleys, respectively. Seedlings were started in 96-cell growing trays filled with a peat-based soil replacer. Soluble fertilizer of formulation 20-20-20 with micronutrients was applied at seven-day intervals for approximately a month. In 1993-94, 15 hybrids were evaluated. At Corozal, seedlings were transplanted 30 November 1993. Soil was from the Corozal series (Aquic Haplohumults). Plots were three 3.04-m-long rows spaced at 0.91 m. Distance between plants within the row was 0.30 m for a density of 36,068 plants per hectare. Water was applied as needed with a sprinkler irrigation system; 10-10-8 fertilizer was used at a rate of 1.51 t/ha in two equally divided applications, at 30 and 60 days after transplant (DAT). Plots were hand hoed for weed control. Except for the supplemental irrigation, these practices are used in the central mountainous region. At Juana Díaz, cabbage was transplanted 27 January 1994. The soil was from the San Antón series (Cumulic Haplustolls). The plot was a 1.9-m wide by 7.6-m long bed covered with plastic mulch. Seedlings were transplanted in a double row within the bed 0.30 m apart. Plant density was the same as for Corozal. Before the installation of the mulch, 10-10-10 fertilizer was broadcast at a rate of 0.10 t/ha. Fertigation consisted of 0.15 t/ha of nitrogen applied weekly from 15 to 71 DAT.

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<sup>6</sup>Fornaris-Rullán, G., I. Beauchamp de Caloni and L. Avilés-Rodríguez, 1989. Head characteristics and acceptability of cabbage cultivars grown in southern Puerto Rico. *J. Agric. Univ. P.R.* 73(4):367-374.

At both locations, preventive insecticides and fungicides were applied according to standard recommendations. Cabbage heads were harvested at seven-day intervals. The average head weight was calculated by dividing yield by the number of heads harvested. Stand was the percentage of heads harvested. Three heads per plot were randomly chosen to determine compactness (mass per unit of area) by the water displacement method. Within the year, the data were analyzed as a split plot with location as the main plot, cultivar as the subplot and four replications.

In 1994-95, seven hybrids were used. Within location, stand density, fertilization, irrigation, pest control and harvest were as for 1993-94. At Corozal, seedlings were transplanted 7 December 1994. Plot size was increased to five 4.56-m long rows. At Juana Díaz, transplanting was 10 January 1995. Plot size remained as in the previous year. Data analyses were as for 1993-94, but three replications were used.

In 1993-94, the location  $\times$  hybrid interaction was significant for yield, head weight and compactness. At Corozal, hybrids did not differ significantly for yield, but significant differences were obtained at Juana Díaz (Table 1). When Juana Díaz alone was considered, 'Sure Vantage' yielded significantly higher than both checks, but 'Savoy King' and 'Tenacity' yielded significantly lower. Sure Vantage, 'Pacifica' and 'Blue Vantage' yielded over 95,000 kg/ha, significantly higher than 'Vantage Point', Savoy King and Tenacity. The hybrids' performances in terms of head weight was similar to the performance in terms of yield. At Corozal, there were no significant differences for head weight. At Juana Díaz, however, Sure Vantage's head weight was greater than that of both checks, whereas head weights of Vantage Point, Savoy King and Tenacity were significantly lower (Table 1). These results suggest that yield was closely associated with head weight.

In cabbage, compactness of the head is related to cultivar use. Regardless of the location, 'Genuine' and Savoy King expressed the typical low compactness of curly cultivars (Table 1). Except for that of 'Charmant', Vantage Point and Pacifica, the head was more compact at Corozal (Table 1). All cultivars, with the exception of Tenacity, yielded more at Juana Díaz than at Corozal. In addition, there was a tendency for earliness when cultivars were grown at Juana Díaz. At this location, harvest was completed 77 DAT. At Corozal, however, harvest was initiated at 78 DAT and was completed 120 DAT.

Differences in hybrid performance between the locations can be attributed to the combination of management and abiotic conditions. For example, slope at Corozal (15 to 20%) was enough to influence the distribution of irrigation. Soil analyses revealed significant differences in soil pH and phosphorus content between locations. Average pH for Corozal was 6.17, and for Juana Díaz 7.37, whereas soil phosphorus was 9 and 36 mg/kg, respectively. Field observations evidenced that weed interference was less under plastic mulch. In 1993-94, cultivar was the only significant source of variation for stand. Sure Vantage, Tenacity and Vantage Point had less than 70% stand, which was significantly lower than that of check 'Izalco' (Table 1). The use of supplemental irrigation at Corozal may have increased the chances for better stand.

As in 1993-94, in 1994-95 the location  $\times$  hybrid interaction was significant for yield and head size. Sure Vantage was one of the best yielders at Juana Díaz, but one of the worst at Corozal (Table 2). Conversely 'Río Verde' performed better at Corozal than at Juana Díaz. Pacifica appeared to be more stable and exhibited the highest yield at both locations. As in 1993-94, there was a direct association between yield and head weight (Table 2). The tendency for earliness at Juana Díaz continued; the group of hybrids were harvested between 62 and 76 DAT. At Corozal, a period of 94 days was needed from transplanting to harvest.

In 1994-95, neither location, hybrid, nor the location  $\times$  hybrid interaction was a significant source of variation for stand or compactness. Average stand was 88%, whereas average compactness was 0.88 g/cm<sup>3</sup>. Since the individual hybrid stand did not differ be-

TABLE 1. — Yield, head weight, compactness and stand of cabbage hybrids at two locations during 1993-94.

| Hybrid                        | Yield   |            | Head weight |            | Compactness       |                   | Stand |
|-------------------------------|---------|------------|-------------|------------|-------------------|-------------------|-------|
|                               | Corozal | Juana Díaz | Corozal     | Juana Díaz | Corozal           | Juana Díaz        |       |
|                               | kg/ha   | kg/ha      | kg/head     | kg/head    | g/cm <sup>3</sup> | g/cm <sup>3</sup> | %     |
| Blue Vantage <sup>1</sup>     | 18,059  | 96,664     | 0.50        | 2.68       | 0.90              | 0.75              | 82    |
| Charmant <sup>1</sup>         | 16,594  | 82,958     | 0.46        | 2.30       | 0.91              | 0.96              | 81    |
| Vantage Point <sup>1</sup>    | 7,475   | 68,770     | 0.21        | 1.77       | 0.92              | 0.92              | 56    |
| Savoy King <sup>1,2</sup>     | 21,851  | 43,824     | 0.61        | 1.22       | 0.73              | 0.52              | 78    |
| Sure Vantage <sup>1</sup>     | 9,433   | 107,088    | 0.26        | 2.97       | 0.97              | 0.79              | 70    |
| Royal Vantage <sup>1</sup>    | 14,704  | 70,839     | 0.41        | 1.96       | 0.90              | 0.80              | 72    |
| Genuine <sup>1,2</sup>        | 14,458  | 90,064     | 0.40        | 2.50       | 0.61              | 0.52              | 86    |
| Tenacity <sup>1</sup>         | 21,468  | 35,708     | 0.60        | 0.99       | 0.83              | 0.64              | 63    |
| Fortuna <sup>1</sup>          | 24,398  | 89,487     | 0.68        | 2.48       | 0.93              | 0.73              | 81    |
| Hybrid Constanza <sup>1</sup> | 7,270   | 73,003     | 0.20        | 2.02       | 0.91              | 0.72              | 66    |
| PSX 57684 <sup>1</sup>        | 12,657  | 90,497     | 0.35        | 2.51       | 1.00              | 0.91              | 81    |
| Pacifica <sup>1</sup>         | 24,014  | 98,937     | 0.67        | 2.74       | 0.88              | 0.86              | 91    |
| Pennant <sup>1</sup>          | 19,565  | 79,315     | 0.54        | 2.20       | 0.91              | 0.80              | 80    |
| Izalco <sup>1,3</sup>         | 20,585  | 69,829     | 0.57        | 1.94       | 0.88              | 0.75              | 91    |
| Rio Verde <sup>1,3</sup>      | 13,239  | 84,834     | 0.36        | 2.35       | 0.90              | 0.72              | 57    |
| LSD <sub>0.05</sub>           |         | 19,136     |             | 0.53       |                   | 0.08              | 19    |

<sup>1</sup>Sakata Seed Co.

<sup>2</sup>Curly hybrid.

<sup>3</sup>Pettoseed Co.

<sup>4</sup>Northrup King Co.

<sup>5</sup>Check.

TABLE 2.—Yield and head weight of cabbage hybrids at two locations during 1994-95.

| Hybrid                    | Yield             |            | Head weight         |            |
|---------------------------|-------------------|------------|---------------------|------------|
|                           | Corozal           | Juana Díaz | Corozal             | Juana Díaz |
|                           | ----- kg/ha ----- |            | ----- kg/head ----- |            |
| Blue Vantage <sup>1</sup> | 28,353            | 24,740     | 0.78                | 0.68       |
| Sure Vantage <sup>1</sup> | 19,508            | 26,844     | 0.54                | 0.74       |
| Tenacity <sup>1</sup>     | 20,720            | 17,715     | 0.57                | 0.49       |
| Pacífica <sup>2</sup>     | 35,502            | 28,350     | 0.98                | 0.79       |
| PSX 57684 <sup>2</sup>    | 20,599            | 20,897     | 0.57                | 0.58       |
| Izalco <sup>2,3</sup>     | 26,051            | 17,310     | 0.72                | 0.48       |
| Río Verde <sup>2,3</sup>  | 30,292            | 22,947     | 0.84                | 0.63       |
| LSD <sub>0.05</sub>       | 6,888             |            | 0.19                |            |

<sup>1</sup>Sakata Seed Co.<sup>2</sup>Northrup King Co.<sup>3</sup>Check.

tween locations, the difference in yield appeared to be associated with average head weight. All hybrids were susceptible to damage by the *Plutella xylostella* larvae. This insect was in part responsible for the reduced yield at Juana Díaz in 1994-95.

The different performances of cabbage by location is indicative that cultivar testing must be performed at each location in order to make appropriate recommendations for cultivar use. The crop cycle of cabbage was completed faster when grown in the coastal valleys. Since stand was not affected by location, yield depended primarily on the average head weight.