Neth. J. agric. Sci. 23 (1975): 224-230

Plant density of year-round chrysanthemums*

A. P. van der Hoeven, C. P. Mol and J. A. van der Steen

Glasshouse Crops Research and Experiment Station, Naaldwijk, the Netherlands

Summary

About 400 ha of glasshouses in Holland are used at present for year-round cropping of chrysanthemums. Very little was known about the effect of plant density on the quantity and quality of the flower yield. This aspect was investigated on the variety Spider on two specialized year-round nurseries. In 1972-1973, fourteen experiments were conducted with plant densities of 40, 54, 60, 64, 70 and 80 plants per meter bed of 1.25 m wide and during the winter of 1973-1974, twelve experiments were conducted with plant populations of 27, 32, 40, 48, 54 and 60 plants per meter bed of 1.25 m wide.

The results showed clearly that as plant density increased, the average number of flowers per stem and the percentage of first-quality stems decreased. During the winter months the effect on quality was very marked, and the price variations between the different grades was great. Wide planting – 40 to 50 plants per meter bed of 1.25 m wide – is therefore recommended for the winter crops. Particularly in winter the low-density crops flowered earliest and most uniformly.

Introduction

The importance of year-round chrysanthemum crops in the Netherlands has increased rapidly since 1960 and the crops occupy at present about 400 ha (Stein, 1973). Year-round chrysanthemums are grown mainly on specialized nurseries (Mol et al., 1973). The plants are not pinched, i.e. one stem is harvested from each plant. More detailed cultural descriptions have been given by Buijs et al. (1968); Searle et al. (1968); Vogelmann (1969). The crop is grown on beds of 1.00 to 1.25 m wide, separated by paths of 0.35 to 0.60 m wide. There has been a tendency to increase the bed width in recent years.

The crop is supported with the aid of flower netting with a mesh size of 12.5 $\times$ 12.5 cm^2. The netting is rolled out over the bed before planting where it serves as a marker.

The plant arrangement is therefore partly determined by the mesh dimensions of the netting. Plant density may be varied by leaving some of the spaces unplanted. It is usual to plant about 60 plants per meter bed of 1.25 m wide in winter and about 70 plants in summer. Flower quality varies according to the season. In winter

* Publikatie van het Proefstation voor de Groenten- en Fruitteelt onder Glas te Naaldwijk No 207.

the stems are thin and weak and the number of flowers per stem is small. Investigation by van der Hoeven (1974) showed that during the winter months of 1973-1974, an average of 17 % of the cuttings planted did not produce marketable flower stems.

Janick & Durkin (1968), working with plant densities of 24 to 97 plants per m², investigated the effect of plant density on the flower diameter of large-flowered, disbudded chrysanthemums. Their work showed that the flower diameter decreased with increasing plant densities. They also found that plants on the outside of the borders were better developed than the plants in the middle of the beds. Gugenhan & Deiser (1970) in Germany studied the effect of plant density with twelve varieties. The crop was cut at the end of November and beginning of December. They found that 48 plants/m² gave the highest yields.

Nieuwenhuijse (1973) found that pinched plants (three stems per plant) produced proportionately fewer shoots at plant densities increasing from 20 to 50 plants/m². His work showed that with increasing plant densities proportionately fewer shoots developed into marketable flowering stems.

As there was little knowledge in the Netherlands about the effect of plant density

Fig. 1. Before planting, netting with a mesh size of 12.5 by 12.5 cm² is laid out over the bed.

on the quantity and quality of the yields of year-round spray chrysanthemums, an investigation was started in 1972.

Materials and methods

The experiments were carried out with the variety Spider grown on loam in Venlo glasshouses on two specialized chrysanthemum nurseries. In 1972-1973, 14 treatments were compared with plant densities of 40, 54, 60, 64, 70 and 80 plants per meter bed of 1.25 m wide. The plants were distributed as evenly as possible over the beds. In 7 of the 14 trials the crop was cut in January and in the other 7 the flowers were cut during the period July to October.

During the winter months of 1973-1974, 12 trials were performed with plant densities of 27, 32, 40, 48, 54 and 60 plants per meter bed. The flowers in these trials were harvested between the beginning of December and the beginning of April. To harvest the flowers the plants were pulled up. The time lapse between the beginning and the end of the harvest was always less than 8 days. The roots were cut off and the number of flowers, the length and the weight of each stem were recorded. The sprays were arbitrarily graded into three quality classes, depending on the weight and strength of the stem and the number of flowers per stem. Stems without flowers, stems which were not salable for one reason or another and cuttings which had not developed a stem were recorded as waste. In each trial plot a bed area of two times 1.00 × 1.25 m^2 was used for the determination of quantitative and qualitative yields. The data recorded were averaged.

Results 1972-1973

Table 1 shows the data obtained from the trials in winter and summer/autumn. Table 1 shows that as plant density increases, the average stem weight and number of flowers per stem decrease. The differences are greatest at low plant densities.

In Fig. 2 the visual quality assessments are given of the trials during the winter months. At increasing plant densities the percentage of first quality decreases and

Table 1. Average stem weight, stem length and number of flowers per stem at increasing plant densities in the winter of 1972-1973 and the summer and autumn of 1973.

Number of plants per 1 m by 1.25 m bed	Stem weight (g)		Stem length (cm)		Number of flowers per stem	
	1972/73	1973	1972/73	1973	1972/73	1973
40	77	151	96	95	6.8	20.7
54	63	121	94	100	5.6	15.0
60	59	112	96	101	5.6	14.5
64	58	105	94	102	5.5	13.2
70	54	98	94	103	5.2	12.0
80	53	89	94	104	5.1	11.5

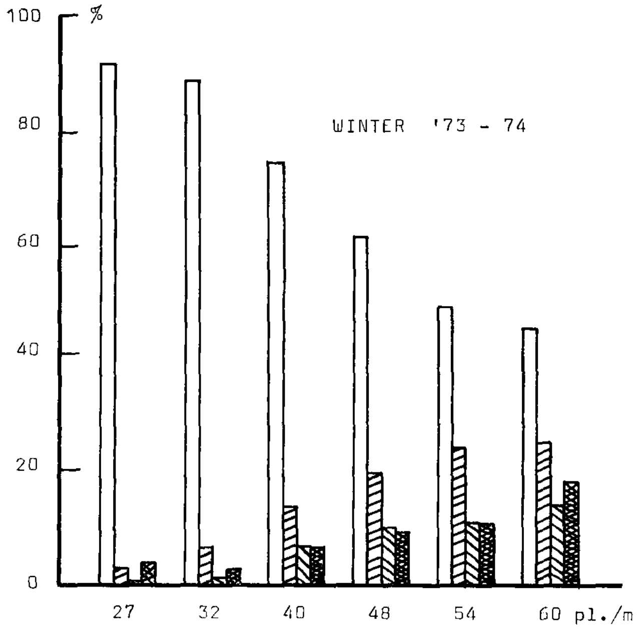

Fig. 2. Average percentages of first, second and third quality and waste at different densities (first, second, third and fourth column, respectively).

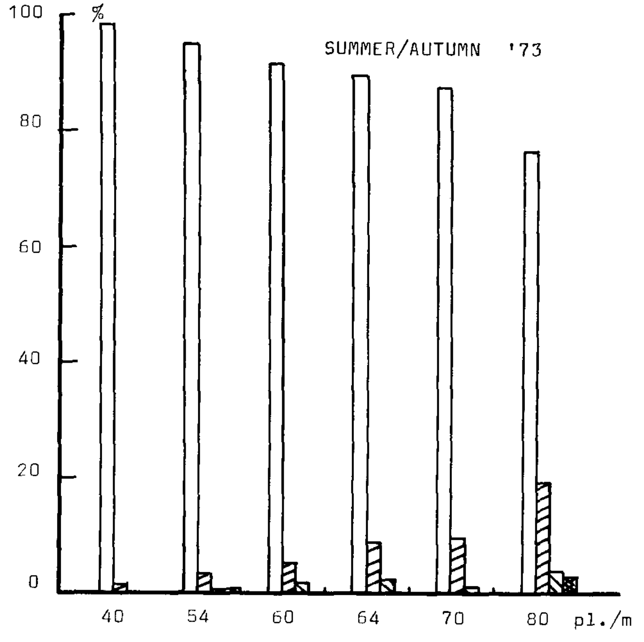

Fig. 3. Average percentages of first, second and third quality and waste at different densities (first, second, third and fourth column, respectively).

Table 2. Average stem weight of quality Class I with increasing plant densities (winter 1972-1973)

Average stem weight (g) at a density of .. plants per bed					
40	54	60	64	70	80
84.2	74.2	74.6	72.6	72.2	69.3

the percentage waste increases. The same applies to the summer months (Fig. 3).

Table 2 shows the average stem weight of the first quality. The figures show that the stems of quality Class I increased in weight and were therefore better as the plant density decreased. The differences in stem weight between the stems of the outer rows and those of the inner rows were greater at high plant densities than at low plant densities.

Results winter season 1973-1974

Some of the results recorded are shown in Table 3. Stem weight and number of flowers per stem increase with decreasing plant densities. Stem length was again hardly affected by plant density. Compared with the winter of 1972-1973, the stems in the following winter were heavier and carried more flowers.

The results of the division into quality classes and waste are given in Fig. 4.

Discussion and conclusions

Up to 1973, growers usually planted 60 plants per meter bed of 1.25 m wide for winter cropping. However, the results obtained with 40 plants in the winter crops were so good that it was decided to include even lower plant densities in the experiments. Particularly in winter the stems remain too light and too thin at the higher plant densities. Differences in quality are reflected more clearly in the returns in winter than in the summer. In summer the average stem weight is more than 100 g,

Table 3. Average stem weight, stem length and number of flowers per stem at increasing plant densities during the winter of 1973-1974.

Number of plants per 1 m by 1.25 m bed	Stem weight (g)	Stem length (cm)	Number of flowers per stem
27	119	105	11.4
32	105	105	10.4
40	92	104	9.1
48	80	103	8.1
54	76	103	7.7
60	76	102	7.5

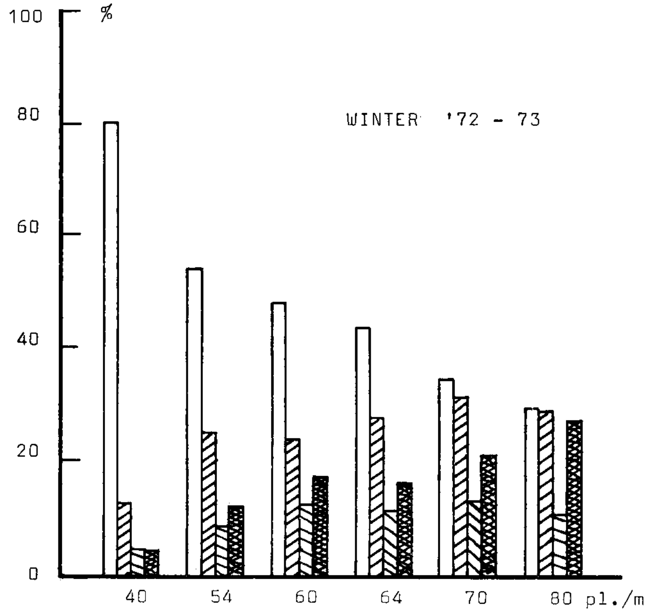

Fig. 4. Average percentages of first, second and third quality and waste at different densities (first, second, third and fourth column, respectively).

and the stems are strong enough. At the lowest plant density most of the stems were too heavy and too big in summer to be bunched easily. In winter the stems are usually much lighter and weaker than in summer.

Economically the optimum plant density depends mainly on the price of the cuttings and the price differences between the quality classes. Table 4 shows an example of the calculation of the financial returns. It is assumed that the cuttings cost *f* 0.10 each (*f* = Dutch guilder) and that stems of first, second and third quality give returns of *f* 0.60, *f* 0.30 and *f* 0.15 each, respectively. The possible differences in labour for the different plant densities have been ignored. This

Table 4. Calculated returns in guilders per m bed (winter 1972-1973).

Number of plants per 1 m by 1.25 m bed	Gross returns	Costs of cuttings per m^2	Returns after deduction of cutting costs
40	20.90	4.00	16.90
54	22.20	5.40	16.80
60	22.80	6.00	16.80
64	22.30	6.40	15.90
70	22.40	7.00	15.40
80	23.10	8.00	15.10

example is concerned with the results obtained in the experiments during the winter of 1972-1973.

Table 4 shows that the nett returns after deduction of cutting costs are highest at the lowest plant density (40). Apart from he higher percentage first quality obtained at the lower plant densities, the average stem weight in the first quality also increased (Table 2).

At lower plant densities the stems could be cut earlier and they were also more uniform. At the higher plant density, the differences in stem weight between the stems of the outer rows and those of the inner rows were greater than at low plant densities. These results confirm those obtained by Janick & Durner (1968).

The results of this work suggest that in the Netherlands Spider chrysanthemums for winter cropping should not be planted closer than 40 to 50 plants per meter bed of 1.25 m wide. For these plant densities the cuttings should be of good quality so that all of them may produce marketable stems.

In summer the highest plant density gave good results with little waste and a high percentage first quality flowers. Because of this, and because price differences between flowers of first and second quality are not usually very great in summer, close planting is recommended for the summer crops.

References

Buijs, G. & J. W. H. van Veen, 1968. [The modern chrysanthemum crop.] Misset, Doetinchem. 272 pp. (in Dutch).

Gugenhan, E. & G. I. A. Deiser, 1970. [Chrysanthemum plant density research.] *Dt. Gärtnerbörse* 70 (48): 1085-1088 (in German.)

Hoeven, A. P. van der, 1974. [Chrysanthemums in winter.] *Tuinderij* 14 (17): 16-17 (in Dutch).

Janick, J. & D. Durkin, 1968. The effect of plant density on greenhouse chrysanthemum quality. *Proc. Am. Soc. hort. Sci.* 93: 583-588.

Mol, C. P. & J. A. van der Steen, 1973. [Year round chrysanthemum culture (1) and (2).] *Vakbl. Bloemisterij* 28 (1): 13; 28 (2): 18-19 (in Dutch).

Nieuwenhuijse, C., 1973. [The development of the autumn crop of spray chrysanthemums under glass in the Bommelerwaard.] Consulentschap voor de Tuinbouw, Tiel. 59 pp. (in Dutch).

Searle, S. A. & B. J. Mackin, 1968. Chrysanthemums the year round. Blandford Press, London. 369 pp.

Stein, A., 1973. Economic aspects of year round chrysanthemums. Landbouw-Economisch Instituut, The Hague. 75 pp. (in Dutch).

Vogelmann, A., 1969. Chrysanthemums. Eugen Ulmer, Stuttgart, 327 pp. (in German.)