International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating: 5.29
IJABR 2025; 9(7): 1096-1099
www.biochemjournal.com
Received: 16-04-2025
Accepted: 19-05-2025

Neha Sharma
Department of Seed Science and technology, Dr. YSP University of Horticulture and Forestry, Solan (Nauni), Himachal Pradesh, India

Ashok Thakur
Department of Seed Science and technology, Dr. YSP University of Horticulture and Forestry, Solan (Nauni), Himachal Pradesh, India

Manish Kumar
Department of Seed Science and technology, Dr. YSP University of Horticulture and Forestry, Solan (Nauni), Himachal Pradesh, India

Narender K Bharat
Department of Seed Science and technology, Dr. YSP University of Horticulture and Forestry, Solan (Nauni), Himachal Pradesh, India

Amit Vikram
Department of Seed Science and technology, Dr. YSP University of Horticulture and Forestry, Solan (Nauni), Himachal Pradesh, India

Corresponding Author:
Neha Sharma
Department of Seed Science and technology, Dr. YSP University of Horticulture and Forestry, Solan (Nauni), Himachal Pradesh, India

To study the effect of planting density and umbel order on seed quality parameters in European carrot cv. Early Nantes

Neha Sharma, Ashok Thakur, Manish Kumar, Narender K Bharat and Amit Vikram

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i7n.4892

Abstract
An investigation was carried out at experiment farm of Vegetable Research Station Kalpa (Kinnaur) of Department of Seed Science and Technology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (HP) during the years 2020-21 and 2021-22 using European carrot cv. Early nantes. It included 16 treatments with four umbel orders (Retaining primary umbels (U_1), Retaining secondary umbels (U_2), Retaining tertiary umbels (U_3) and Retaining all umbels (U_4)) and four planting densities (45cm×30cm- 6 plants (D_1), 45cm×15cm- 12 plants (D_2), 30cm×30cm- 9 plants (D_3) and 30cm×15cm- 18 plants (D_4)) each replicated four times. Laboratory tests include 1000 seed weight (g), germination (%), SVI-I, SVI-II and accelerated ageing test. The results indicated that 45cm×30cm density (D_1) with retention of primary umbels (U_1) showed the highest 100 seed weight (1.76g) seed germination rates (87.12%), vigour Index-I (1310.60), vigour index-II (227.90) and germination after accelerated ageing test (67.12%), suggesting superior seed quality. Optimizing planting density and umbel management are critical for improving European carrot seed quality, with potential for further agronomic refinement in future research.

Keywords: European carrot, planting density, umbel order, seed quality, germination test, seed vigour index, accelerated ageing test, Kalpa Kinnaur

Introduction

Indeed, vegetables, are crucial for providing essential nutrients such as vitamins, minerals and antioxidants which contribute significantly to human health. A diet rich in vegetables can help prevent various chronic diseases, support immune function and enhance overall well-being. In addition to health benefits, vegetable production also plays vital role in the economic development of countries. For example, India, which ranks second in vegetable production globally after China, benefits economically through job creation, trade and supporting the livelihoods of millions of farmers and workers in the agricultural sector. Area and production of vegetable in India is 10.35 million hectares and 191.77 million metric tonnes, respectively (Anonymous, 2019). With the rising vegetable consumption and more emphasis on export of vegetables, there is an urgent need to increase the production of vegetables through the use of quality seed. Therefore, supply of good quality seed is an important crucial factor.

The carrot (*Daucus carota* L.) belongs to the Apiaceae family and is believed to be native to the Mediterranean region (Shinohara, 1984) [10], where its cultivation as a crop also began. Carrots are among the most ancient vegetables and are grown in temperate regions during spring, summer and autumn. In tropical and subtropical countries, carrots are typically produced during the winter months to take advantage of the cooler growing conditions. This versatility in growing seasons allows carrots to be a widely available and nutritious food source throughout the year in various parts of the world. Among all vegetables, the carrot stands out for its high nutritional value and versatility in culinary applications and long term storage. Carrots are rich in carotene, thiamine, riboflavin, iron, carbohydrates, Vitamin-B and C, and sugars (Sharfuddin and Siddique, 1985) [9]. The root sucrose content in carrot is notably high, with endogenous sugar levels being 10 times greater than those of glucose and fructose (Bose and Some, 1990) [4].

In addition to its nutritional benefits, carrots have important medicinal properties. The play a crucial role in preventing blindness in children by providing vitamin A, which is essential for maintaining healthy vision. This make carrot not only a nutritious food but also a significant contributor to overall health and well-being. The Area under carrot crop in India is reported to be 97000 hectares with annual production of 1648000 metric tonnes, whereas, Himachal Pradesh accounts for 7.67 (000) tonnes production of carrot (Anonymous, 2018).

The imported seeds are relatively expensive which are not always available in time for sowing. Hence, cultivation of good quality carrot becomes an uncertainty every year. On the other hand, locally produced seeds cannot cope with the requirement. To boost up carrot production in the country timely supply of quality seed in desired quantity should be ensured, which is possible only by improving local seed production technology. Carrot is grown from the true seeds and successful production dependent on sustainable and satisfactory supply of good quality seeds (Macdonald and Copland, 1998) [7].

Planting density not only plays an important role in seed yield but also on seed quality parameters. As the planting density increases and reaches maximum, at which point further increase in planting density results in reduced yield. Umbel order and its size also influence the seed quality and yield.

Carrot consists of many umbel orders. The start of flowering, seed development and seed ripening in the carrot crop do not occur synchronously on each umbel order (Hawthorn *et al*., 1962) [6]. Relationship between planting density and umbel order in carrot seed production is very useful in optimizing plant population for maximum seed quality (Olivia *et al*., 1988) [8].

Materials and Methods

The experiments were conducted experiment farm of Vegetable Research Station Kalpa (Kinnaur) of Department of Seed Science and Technology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (HP), during 2020-2021 and 2021-2022. Under this study European carrot cv. Early nantes was used and there were 16 treatments *viz* Retaining primary umbels + 45 cm×30 cm planting density (T_1) Retaining primary umbels + 45 cm×15 cm planting density (T_2), Retaining primary umbels + 30 ccm×30 cm planting density (T_3), Retaining primary umbels + 30 cm×15 cm planting density (T_4), Retaining secondary umbels + 45 cm×30 cm planting density (T_5), Retaining secondary umbels + 45 cm×15 cm planting density (T_6), Retaining secondary umbels + 30 cm×30 cm planting density (T_7), Retaining secondary umbels + 30 cm×15 cm planting density (T_8), Retaining tertiary umbels + 45 cm×30 cm planting density (T_9), Retaining tertiary umbels + 45 cm×15 cm planting density (T_{10}), Retaining tertiary umbels + 30 cm×30 cm planting density (T_{11}), Retaining tertiary umbels + 30 cm×15 cm planting density (T_{12}), Retaining all umbels + 45 cm×30 cm planting density (T_{13}) Retaining all umbels + 45 cm×15 cm planting density (T_{14}), Retaining all umbels + 30 cm×30 cm planting density (T_{15}) and Retaining all umbels + 30 cm×30 cm planting density (T_{16}).

Data were statistically analysed as suggested by Gomez and Gomez (1984) [5]. Seed quality parameters studied were 1000 seed weight (g), seed germination (%), SVI-I (length), SVI-II (mass) and germination after accelerated ageing test

Results and Discussion

It is apparent from the data (Table 1) that all the treatments produced significant effects on quality parameters.

1000 seed weight

An introspection of the data (Table 1) revealed significant effect of umbel orders, planting density and their interactions on 1000 seed weight. Among the umbel orders, significantly highest 1000 seed weight (1.68 g) was recorded in U_1 (Retaining of primary umbels) and (1.33 g) in D_1 (45 cm×30 cm-6 plants). This might be due to the fact that better seed quality was obtained from primary umbels followed by the secondary umbels and whole plant, while tertiary gave poor quality seeds. Ajmad *et al*. (2005) [1] also reported that in carrot better seed quality were obtained from primary umbels. Among the interactions, U_1D_1 (Retaining of primary umbels+ 45 cm×30 cm-6 plants) resulted in highest 1000 seed weight (1.76 g). These results are in line with the findings of Sutradhar *et al*. (2017) [11].

Seed Germination (%)

A perusal of the data (Table 2) exhibited significant effect of umbel order, planting density and their interactions on seed germination (%). The maximum seed germination (85.90%) was recorded in U_1 (Retaining of primary umbels) The possible reasoning for this has already been discussed earlier under 1000 seed weight. Ajmad *et al*. (2005) [1] in carrot also observed higher germination (%). In case of planting density, maximum seed germination (78.18%) was recorded in D_1 (45 cm×30 cm-6 plants). Among the interactions, highest seed germination (87.12%) U_1D_1 (Retaining of primary umbels+ 45cm×30cm-6 plants).

Seed vigour Index-I and Seed vigour index-II

It is extrapolated from Table 3 and 4 that umbel order, planting density and their interactions revealed significant effect on SVI-I and SVI-II. U_1 (Retaining of primary umbels) showed maximum SVI-I and SVI-II (1234.65 and 206.89, respectively) Among planting density, D_1 (45 cm×30 cm-6 plants) showed highest SVI- I and SVI-II (975.94 and 163.76, respectively). As SVI-I and SVI-II is derived from the product of germination (%) and seedling lengthy and seedling dry weight, respectively both of which were higher in plants having only primary umbels with lowest planting density i.e. 6 plants/plot so more SVI-I and SVI-II was obvious. These results make agreement with the findings of Sutradhar *et al*. (2017) [11] in carrot and Thakur *et al*. (2015) [12] in carrot. In case of interactions, U_1D_1 had preeminent SVI-I and SVI-II (1310.60 and 227.90, respectively).

Seed Germination after accelerated ageing test (%)

Analysis of variance revealed that umbel order, planting density and their interactions had significant effect on germination of seeds after accelerated ageing test (Table 5). U_1 (Retaining of primary umbels) showed significantly maximum seed germination (65.81%). In case of planting density, highest seed germination (57.93%) was recorded in D_1 (45 cm×30 cm-6 plants). Among interactions, significantly maximum seed germination after accelerated ageing test (67.12%) was recorded with U_1D_1 (Retaining of primary umbels+ 45 cm×30 cm-6 plants).

Table 1: Effect of planting density and umbel order on 1000 seed weight (g)

Particulars	Year 2020-21					Year 2021-22					Pooled				
	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean
D_1	1.76	1.42	0.98	1.16	1.33	1.75	1.49	0.96	1.09	1.32	1.76	1.45	0.97	1.13	1.33
D_2	1.66	1.39	0.94	1.08	1.27	1.63	1.33	0.90	1.01	1.22	1.65	1.36	0.92	1.04	1.24
D_3	1.70	1.41	0.95	1.11	1.29	1.69	1.45	0.94	1.06	1.29	1.70	1.43	0.94	1.08	1.29
D_4	1.61	1.36	0.90	1.03	1.23	1.62	1.41	0.88	1.00	1.23	1.61	1.39	0.89	1.02	1.23
Mean	1.68	1.39	0.94	1.09		1.67	1.42	0.92	1.04		1.68	1.41	0.93	1.07	

$CD_{0.05}$			
umbel order (U)	0.02		
Planting density (D)	0.02		
Year (Y)	NS		
Umbel order × planting density (U×D)	NS		
Y×U×D	NS		

Table 2: Effect of planting density and umbel order on seed germination (%)

Particulars	Year 2020-21					Year 2021-22					Pooled				
	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean
D_1	87.00	83.00	66.50	76.00	78.12	87.25	83.00	66.00	76.75	78.25	87.12	83.00	66.25	76.37	78.18
D_2	85 .00	81.00	63.00	74.00	75.87	85.75	81.75	63.75	74.50	76.43	85.62	81.37	63.37	74.25	76.15
D_3	86.00	82.00	65.25	75.50	77.18	86.50	82.25	64.50	75.75	77.25	86.25	82.12	64.87	75.62	77.21
D_4	84.50	80.25	61.50	72.50	74.68	84.75	81.00	62.50	72.75	75.25	84.62	80.62	62.00	72.62	74.96
Mean	85.75	81.56	64.06	74.50		86.06	82.00	64.18	74.93		85.90	81.78	64.12	74.71	

$CD_{0.05}$			
umbel order (U)	0.67		
Planting density (D)	0.67		
Year (Y)	NS		
Umbel order × planting density (U×D)	NS		
Y×U×D	NS		

Table 3: Effect of planting density and umbel order on SVI-I (length)

Particulars	Year 2020-21					Year 2021-22					Pooled				
	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean
D_1	1312.70	1050.42	647.90	883.57	973.64	1308.50	1054.00	650.32	900.15	978.24	1310.60	1052.21	649.11	891.86	**975.94**
D_2	1210.38	943.55	512.35	788.10	863.59	1204.65	948.37	539.62	813.95	876.64	1207.50	945.96	525.98	801.02	870.12
D_3	1239.03	1008.03	600.22	834.15	920.36	1268.16	986.92	598.25	835.07	922.10	1253.60	997.48	599.23	834.61	921.23
D_4	1165.95	889.61	462.07	740.90	814.63	1167.87	907.12	478.20	774.72	831.32	1166.91	898.36	470.14	757.81	823.30
Mean	1232.01	972.90	555.63	811.68		1237.29	974.10	566.60	830.97		1234.65	973.50	561.11	821.32	

$CD_{0.05}$			
umbel order (U)	20.65		
Planting density (D)	20.65		
Year (Y)	NS		
Umbel order × planting density (U×D)	NS		
Y×U×D	NS		

Table 4: Effect of planting density and umbel order on SVI-II (mass)

Particulars	Year 2020-21					Year 2021-22					Pooled				
	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean
D_1	225.80	168.31	112.71	142.67	162.37	230.01	174.80	111.29	144.52	165.15	227.90	171.55	112.00	143.59	163.76
D_2	195.37	161.59	100.24	136.15	148.34	209.19	159.58	99.72	136.50	151.25	202.28	160.58	99.98	136.33	149.79
D_3	208.79	165.01	106.15	140.80	155.19	217.80	166.74	104.24	141.24	157.46	213.29	165.87	105.20	140.94	156.30
D_4	181.87	157.12	94.06	128.66	140.43	186.33	159.94	94.53	130.59	142.85	184.10	158.34	94.29	129.62	41.62
Mean	202.96	163.01	103.29	137.07		210.83	165.26	102.44	138.17		206.89	164.13	102.87	137.62	

$CD_{0.05}$			
umbel order (U)	3.78		
Planting density (D)	3.78		
Year (Y)	NS		
Umbel order × planting density (U×D)	7.56		
Y×U×D	NS		

Table 5: Effect of planting density and umbel order of seed on germination after accelerated ageing test

Particulars	Year 2020-21					Year 2021-22					Pooled				
	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean	U_1	U_2	U_3	U_4	Mean
D_1	66.75	62.00	47.00	55.00	57.68	67.50	62.50	47.25	55.50	58.18	67.12	62.25	47.12	55.25	57.93
D_2	65.00	59.75	46.00	53.75	56.12	65.75	60.00	46.50	54.00	56.56	65.37	59.87	46.25	53.87	56.34
D_3	65,50	61.00	45.50	54.75	56.68	66.50	61.50	46.00	54.75	57.18	66.00	61.25	45.75	54.75	56.93
D_4	64.50	58.25	44.50	51.50	54.68	65.00	59.50	45.75	52.00	55.56	64.75	58.87	45.12	51.75	55.12
Mean	65.43	60.25	45.75	53.75		66.18	60.87	46.37	54.06		65.81	60.56	46.06	53.90	
$CD_{0.05}$															
umbel order (U)	0.92														
Planting density (D)	0.92														
Year (Y)	NS														
Umbel order × planting density (U×D)	NS														
Y×U×D	NS														

Conclusion

From the present investigations, it can be concluded that among the four umbel orders, U_1 i.e. retaining of primary umbels was significantly superior over other three umbel orders for the seed quality parameters. Similarly, in case of planting density, D_1 (45 cm×30 cm-6 plants) was significantly superior for seed yield parameters. Among the interactions, the treatment combination U_1D_1 i.e. Retaining of primary umbel + 45 cm×30 cm-6 plants planting density was found superior over all other treatment combinations in term of all seed quality parameters namely, 1000 seed weight (g), seed germination (%), SVI-I (length), SVI-II (mass) and seed germination after accelerated ageing test (%).

Therefore, U_1 i.e. retaining of primary umbel in combination with D_1 (45 cm×30 cm) can be recommended for commercial cultivation after multi-location yield trials for getting the quality seeds in European carrot cv. Early nantes under high-hill conditions of Himachal Pradesh.

References

1. Amjad M, Anjum MA, Asef I. Impact of mother root size and umbel order on the yield and quality of seed produced and resulting roots in carrot. Plant Breed Seed Sci. 2005;51:49-56.
2. National Horticulture Board (NHB). 2018. Available from: http://nhb.gov.in
3. National Horticulture Board (NHB). 2019. Available from: http://nhb.gov.in
4. Bose TK, Som MG. Vegetable crops in India. Calcutta: Naya Prakash; 1990. p. 408-422.
5. Gomez KA, Gomez AA. Statistical procedures for agricultural research. New York: John Wiley and Sons; 1984. 680 p.
6. Hawthorn LR, Toole EH, Toole VK. Yield and viability of carrot seed as affected by position of umbel and time of harvest. Proc Am Soc Hortic Sci. 1962;80:401-407.
7. MacDonald MB, Copeland LO. Seed production: principles and practices. 749 p.
8. Olivia RN, Tissaoni T, Bradford KJ. Relationship of plant density and harvest index to seed yield and quality in carrot. J Am Soc Hortic Sci. 1988;113:532-537.
9. Sharffudin AFM, Siddique MA. Shabjee Biggan. 1st ed. Mymensingh: BAU; 1985. 11 p.
10. Shinohara S. Vegetable seed production technology of Japan. Tokyo: Nishioris Shingapore; 1984. p. 123-142.
11. Sutradhar H, Pandita VK, Tomar BS. Studies on contribution of umbel order on seed yield and quality under different planting ratio and plant spacing in carrot hybrid, Pusa Vasuda. J Veg Sci. 2017;44:91-94.
12. Thakur AK, Vikram A, Kanwar HS, Bhardwaj RK. Effect of storage and umbel orders on seed quality of European carrot cultivar Solan Rachna under cold desert conditions of Himachal Pradesh. Int J Bioresour Stress Manag. 2015;6:63-67.