



Varietal Evaluation of Black Cumin (*Nigella sativa* L.) in Prayagraj Agro-Climatic Conditions

P. T. Akash Krishnan^{a*}, Devi Singh^{a#}, Vikram Singh^{a‡} and Vijay Bahadur^{a#}

^a Department of Horticulture, Naini of Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2022/v12i1131142

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/90844>

Original Research Article

Received 07 August 2022
Accepted 12 August 2022
Published 17 August 2022

ABSTRACT

An Experiment on black cumin was conducted during November to April 2021-2022, in Horticulture Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences Prayagraj (U.P.) India. The results of the investigation, regarding the performance of the 7 variety of black cumin *i.e.* Ajmer Nigella-1, Ajmer Nigella-20, Rajendra Shyama, *Nigella Sativa*, Local variety -1, Azad Kolonji, Local variety- 2 obtained from different sources to find out the best performance in terms of growth and yield in prayagraj agro climatic conditions. The experiment was conducted in Randomized Block Design, were each variety replicated thrice the results from the present investigation concluded that black cumin genotype Azad Kolonji was recorded with maximum number of flowers / plant (77.87), number of umbels / plant (57.27), Seed / umbel (95.73), Seed yield t/ha (2.48) and with maximum gross return, net return and Cost Benefit Ratio of (4.12) which was found to be more productive and economically viable.

Keywords: *Black cumin; Varieties; agro-climatic conditions.*

^{*} PG Student;

[#] Associate Professor;

[‡] Assistant Professor;

^{*}Corresponding author: E-mail: akashpt871@gmail.com;

1. INTRODUCTION

Black cumin (*Nigella sativa* L.) is an annual spice crop belong to family Ranunculaceae .Black cumin is a diploid species with $2n = 12$. It is also called kalongi and a main spice crop in india. Black cumin mostly grown in cold and dry regions with a temperature range of 5- 25°C with optimum of 12 -14°C and rainfall of 400 -500 mm are most suitable climatic condition for its proper growth and yield. Black cumin grow in all type of soil but loamy sand soil is best. It can be grown from sea level to 2500 meter above sea level, with yields decreasing as altitude rises.

The crop is native to the Mediterranean region and has been used by numerous cultures and civilizations for thousands of years. It grows wild in the Mediterranean region of Turkey and Cyprus (Davis, 1965). Black seed, black caraway, roman coriander, fennel flower, and kalonji are some of the other names for it. India, Sri Lanka, Bangladesh, Afghanistan, Pakistan, Egypt, Iran, and other important producers are listed below. Madhya Pradesh, Bihar, Punjab, Jammu and Kashmir, Himachal Pradesh, Rajasthan, West Bengal, and Tamil Nadu are the leading producers of nigella in India. Because of its many uses, it is one of the most significant medicinal herbs [1-5]. For a variety of purposes, black cumin is used whole or crushed. Its seed has long been used in traditional medicine to cure diarrhoea, jaundice, amenorrhoea, helminthiasis, paralysis, ophthalmology, and asthma, among other ailments [6-10].

Varieties are selected based on its adaptation to the soil, climate conditions and resistance/tolerance to pests and diseases. some important varieties of black cumin are Ajmer Nigella-1 is developed by ICAR-National Research Centre on Seed Spices, Ajmer. It is suitable for cultivation in semi-arid region under irrigated conditions. The plants are 30-35 cm in height. This variety takes 135 days to reach seed maturity and has resistance to root rot. The

average seed yield of Ajmer Nigella-1 is 800kg ha⁻¹ .Ajmer Nigella-20 is developed by ICAR-National Research Centre on Seed Spices, Ajmer through mass selection. This variety matures in 140-150 days, suitable for all parts of Rajasthan. Average yield of this variety is 10-12 q ha⁻¹. Azad Kolonji variety developed at Chandra Shekhar Azad University of Agriculture and Technology, Regional Research Station, Kalyanpur, Kanpur. It takes about 135- 145 days to produce seed. Average seed yield of this variety is 900-1000 kg ha⁻¹. Rajendra Shyama was released from Department of Horticulture,Tirhut College of Agriculture, RAU Dholi (Bihar). This variety is recommended for West Bengal and Bihar States. It takes above 140-150 days to produce seed. Average seed yield is 700-800 kg ha⁻¹. Pant Krishna variety was developed by pure line selection from indigenous selection at Govind Ballabh Pant University of Agriculture Science and Technology, Pantnagar. Plants of this variety are medium, bold seed and suitable for cultivation in U.P. and Uttarakhand. NS-44 This variety is developed by Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur,Madhya Pradesh. It yields 4.5 to 6.5 qtl. ha⁻¹ and matures in 140 – 150 days. NS-32, is also cultivar produces 4.5 – 5.5 quintal/ha. seed and matures in 140 – 150 days. It was development by Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh. Kalajeera Kalajeeraa variety of Nigella takes 135-145 days to produce seed. Average seed yield is 400– 500 kg ha⁻¹.

2. MATERIALS AND METHODS

The experiment conducted on the topic of “varietal evaluation of black cumin (*Nigella sativa* L.) in prayagraj agro-climatic conditions” to find out best variety in Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and science, Prayagraj during November –April 2021 -22. The experiment was calculated in Randomized Block Design having 7 treatment with 3 replications.

Table 1. List of varieties

| No of varieties | Name of Varieties | Sources |
|-----------------|-----------------------|---|
| V ₁ | Ajmer Nigella-1 | NRCSS, Ajmer |
| V ₂ | Ajmer Nigella-20 | NRCSS, Ajmer |
| V ₃ | Rajendra Shyama | Tirhut college of agriculture, Dholi, Bihar |
| V ₄ | <i>Nigella sativa</i> | JNKVV,MP |
| V ₅ | Local variety -1 | Uttar pradesh |
| V ₆ | Azad kolonji | CSA University of agriculture, Kanpur. |
| V ₇ | Local variety- 2 | Uttar pradesh |

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

- The minimum Days to Germination was found in T₆ (Azad kolonji) variety that is 11.13 days, Followed by the V₃ (Rajendra Shyama variety) 12.07 days and maximum number of days to germination was recorded in the Variety V₄ (*Nigella sativa*) 15.93 days

The days to germination is an important character. Which indicate earliness or lateness of the crop. Better germination is due to good permeability of water to seed coat. The earliness and late germination will affect the maturity of crop. Time of sowing and climatic condition are important factor that influence germination of seed Similar results were also observed by Haq et al., [11], Shadia et al., [12] in *Nigella Sharangi* et al., [13] and Naghera et al., [14] in coriander are accordance with the present findings.

- The maximum Plant Height at 30 days was found in V₆ (Azad kolonji) variety that is 12.51 cm, Followed by the variety V₃ (Rajendra Shyama)variety 9.25 cm, and minimum plant height at 30 days was recorded in the variety V₄ (*Nigella sativa*) 4.13 cm.

The maximum Plant Height at 60 days was found in V₆ (Azad kolonji) variety that is 22.68 cm, Followed by the variety V₃ (Rajendra Shyama) variety 18.30 cm, and minimum plant height at 60 days was recorded in the variety V₄ (*Nigella sativa*) 11.38 cm.

The maximum Plant Height at 90 days was found in V₆ (Azad kolonji) variety that is 55.73 cm, Followed by the variety V₃ (Rajendra Shyama) variety 43.81 cm, and minimum plant height at 90 days was recorded in the variety V₄ (*Nigella sativa*) 22.30 cm.

The maximum Plant Height at 120 days was found in V₆ (Azad kolonji) variety that is 78.11 cm Followed by the variety V₃ (Rajendra Shyama) variety 69.79 cm, and minimum plant height at 120 days was recorded in the variety V₄ (*Nigella sativa*) 44.35 cm.

The mean value of plant height was found Significant at different variety of Black cumin is an important character. If height of the plant increase primary and secondary branches in the plant also increase thus yield of the plant

increase. The type of variety, difference in cropping season, type of soil and the type of management that can increase or decrease the available fertilizer efficiency. Similar results were observed by Datta [15] and Weiss [16].

- The maximum plant height at harvesting time was found in T₆ (Azad kolonji) variety that is 85.01 cm followed by the V₃ (Rajendra Shyama) variety 76.64 cm and minimum plant height at harvesting time was recorded in the variety V₄ (*Nigella sativa*) 53.88 cm. The type of variety, difference in cropping season, type of soil and the type of management that can increase or decrease the available fertilizer efficiency. Similar results were observed by Datta [15] and Weiss [16].
- The result recorded that, the maximum Number of Primary Branches / Plant was found in T₆ (Azad kolonji) variety that is 9.87 followed by the V₃ (Rajendra Shyama) variety 8.20 and Number of Primary Branches / Plant was recorded in the variety V₄ (*Nigella sativa*) 5.93.

Number of primary branch increase significantly with broad row spacing., sowing date and variety type directly influence the number of primary Branches / Plant similar findings reported in Luchon and Sarat [17].

- In terms of Day of Maturity ,the minimum Days of maturity was found in T₆ (Azad kolonji) variety that is 124.13 days, Followed by the V₃ (Rajendra Shyama variety) 127.40 days and maximum number of Days of maturity was recorded in the Variety V₄ (*Nigella sativa*) 138.13 days
- The minimum Day to First Flowering was found in T₆ (Azad kolonji) variety that is 51.0 days, Followed by the V₃ (Rajendra Shyama variety) 55.40 days and maximum Day to First Flowering was recorded in the Variety V₄ (*Nigella sativa*) 67.87 days.

Time of sowing and climatic condition are important factor that influence flowering of crop. When seed will germinate early the growth and flowers will come early. Similar results were also observed by Haq et al., [11], Shadia et al., [12] in *Nigella Sharangi* et al., [13] and Naghera et al., [14] in coriander are accordance with the present findings.

- The result recorded that, the minimum Day to 50% Flowering was found in T₆ (Azad

kolonji) variety that is 64.27 days, Followed by the V₃ (Rajendra Shyama variety) 67.87 days and maximum Day to 50% Flowering was recorded in the Variety V₄ (*Nigella sativa*) 80.20 days.

Time of sowing and climatic condition are important factor that influence flowering of crop. When seed will germinate early the growth and flowers will come early. Similar results were also observed by Haq et al., [11], Shadia et al., [12] in nigella Sharangi et al., [13] and Naghera et al., [14] in coriander are accordance with the present findings.

- The result recorded that, the maximum Number of Flowers / Plant was found in T₆ (Azad kolonji) variety that is 77.87 followed by the V₃ (Rajendra Shyama) variety 69.53 and minimum Number of Flowers / Plant was recorded in the variety V₄ (*Nigella sativa*) 46.67.

Number of Flowers / Plant increase with increase in number of primary and secondary branches in nigella. In nigella every flowers came in terminal portion of the branches so we can say that number of branches increase flowers will also increase. Varieties also influence flowering and yield of the crop.

3.2 Yield and Quality Parameters

- The result recorded that, the maximum Number of Umbels / Plant was found in T₆ (Azad kolonji) variety that is 57.27 followed by the V₃ (Rajendra Shyama) variety 45.87 and minimum Number of Umbels / Plant was recorded in the variety V₄ (*Nigella sativa*) 29.20.

The type of variety, difference in cropping season, type of soil and the type of management that can increase or decrease the available fertilizer efficiency. Similar results were observed by Datta Singh et al., [15] and Weiss Singh et al., [16].

Because of the relative optimum plant density in comparison to low seed rate and high seed rate treatment. In a study by Singh et al., [18], seed rate of 10 kg/ha resulted the height mean seed yield and number of seed per capsule.

- In terms of Umbels Diameter, the maximum Umbel Diameter was found in T₆ (Azad kolonji) variety that is (1.43 cm) followed by the V₃ (Rajendra Shyama) variety (1.28 cm) and minimum Umbel

Diameter was recorded in the variety V₄ (*Nigella sativa*) (1.08 cm).

The type of variety, difference in cropping season, type of soil and the type of management that can increase or decrease the available fertilizer efficiency. Similar results were observed by Datta [15] and Weiss [16] Because of the relative optimum plant density in comparison to low seed rate and high seed rate treatment. In a study by Singh et al. [18], seed rate of 10 kg/ha resulted the height mean seed yield and number of seed per capsule.

- The result recorded that, the maximum Seeds / Umbel was found in T₆ (Azad kolonji) variety that is 95.73 followed by the V₃ (Rajendra Shyama) variety 83.0 and minimum Seeds / Umbel was recorded in the variety V₄ (*Nigella sativa*) 56.07.

The type of variety, difference in cropping season, type of soil and the type of management that can increase or decrease the available fertilizer efficiency. Similar results were observed by Datta [15] and Weiss [16] Because of the relative optimum plant density in comparison to low seed rate and high seed rate treatment. In a study by Singh et al. [18], seed rate of 10 kg/ha resulted the height mean seed yield and number of seed per capsule.

- The result recorded that, the maximum Seeds Yield t/ha was found in T₆ (Azad kolonji) variety that is 2.48 t/ha followed by the V₃ (Rajendra Shyama) variety 2.29 t/ha and minimum Seeds Yield /Plant was recorded in the variety V₄ (*Nigella sativa*) 1.34 t/ha.

Seed yield increase with increase in number of primary branches and secondary branches [19-21]. Some black cumin varieties are branching type and some others are not thus yield of the plant is influence by type of variety, difference in cropping season, type of soil and the type of management that can increase or decrease the available fertilizer efficiency. Similar results were observed by Datta [15] and Weiss [16] Because of the relative optimum plant density in comparison to low seed rate and high seed rate treatment. In a study by Singh et al. [18], seed rate of 10 kg/ha resulted the height mean seed yield and number of seed per capsule. The seed yield was heigher with medium row spacing of 30 cm because of adequate plant population and also due to less competition between the plant for light, water and nutrient. Das et al. [22] reported similar findings.

Table 2. Performance of black cumin (*Nigella sativa* L.) in terms of days to germination, plant height (cm), height at harvesting time, primary branches / plant

| Varieties | Varietal Combination | Day to Germination | Plant Height (cm) | | | | Height at Harvesting Time | Primary Branches / Plant |
|----------------|----------------------|--------------------|-------------------|--------|--------|---------|---------------------------|--------------------------|
| | | | 30 DAS | 60 DAS | 90 DAS | 120 DAS | | |
| V ₁ | AJMER NIGELLA -1 | 12.60 | 6.67 | 14.43 | 28.52 | 54.54 | 59.71 | 6.20 |
| V ₂ | AJMER NIGELLA -20 | 15.27 | 5.23 | 13.05 | 23.19 | 47.89 | 54.84 | 6.00 |
| V ₃ | RAJENDRA SHYAMA | 12.07 | 9.25 | 18.30 | 43.81 | 69.79 | 76.64 | 8.20 |
| V ₄ | NIGELLA SATIVA | 15.93 | 4.13 | 11.38 | 22.30 | 44.35 | 53.88 | 5.93 |
| V ₅ | LOCAL VARIETY -1 | 12.20 | 8.22 | 17.07 | 38.33 | 63.71 | 69.09 | 7.67 |
| V ₆ | AZAD KALONJI | 11.13 | 12.1 | 22.68 | 55.73 | 78.11 | 85.01 | 9.87 |
| V ₇ | LOCAL VARIETY -2 | 12.33 | 8.05 | 15.79 | 34.93 | 58.05 | 63.31 | 7.20 |
| | S.Ed (±) | 0.36 | 0.26 | 0.50 | 0.55 | 0.78 | 0.97 | 0.30 |
| | C.D at 5% | 0.78 | 0.57 | 1.09 | 1.20 | 1.71 | 2.11 | 0.66 |
| | C.V | 3.35 | 4.15 | 3.80 | 1.92 | 1.62 | 1.79 | 5.09 |

Table 3. Performance of black cumin (*Nigella sativa* L.) in terms of day of maturity, day to first flowering (day), day to 50% flowering, number of flowers / plant, number of umbel per plant, umbels diameter (cm), number of seed per umbel, seed yield , test weight (g), TSS content

| Varieties | Day of Maturity | Day to First Flowering (Day) | Day to 50% Flowering | Number of Flowers / Plant | Number of Umbels / Plant | Umbel Diameter (cm) | Seeds / Umbel | Seeds Yield t/ha | Test Weight (g) | TSS Content (°Brix) | |
|----------------|------------------|------------------------------|----------------------|---------------------------|--------------------------|---------------------|---------------|------------------|-----------------|---------------------|------|
| V ₁ | 132.93 | 66.07 | 74.27 | 66.53 | 43.33 | 1.11 | 76.40 | 1.64 | 2.71 | 3.98 | |
| V ₂ | 135.80 | 65.73 | 76.60 | 56.27 | 35.27 | 1.10 | 66.40 | 1.39 | 2.61 | 3.83 | |
| V ₃ | 127.40 | 55.40 | 67.87 | 69.53 | 45.87 | 1.28 | 83.0 | 2.29 | 3.42 | 5.96 | |
| V ₄ | 138.13 | 67.87 | 80.20 | 46.67 | 29.20 | 1.08 | 56.07 | 1.34 | 2.41 | 3.71 | |
| V ₅ | 128.53 | 57.47 | 68.20 | 61.07 | 38.67 | 1.23 | 82.60 | 2.14 | 3.27 | 5.8 | |
| V ₆ | 124.13 | 51.0 | 64.27 | 77.87 | 57.27 | 1.43 | 95.73 | 2.48 | 4.05 | 6.00 | |
| V ₇ | 130.33 | 60.93 | 70.93 | 64.13 | 41.93 | 1.16 | 80.67 | 2.02 | 3.54 | 4.75 | |
| | S.Ed (±) | 1.40 | 0.55 | 0.63 | 0.81 | 1.14 | 0.04 | 0.81 | 0.16 | 0.10 | 0.14 |
| | C.D at 5% | 3.04 | 1.21 | 1.37 | 1.76 | 2.48 | 0.09 | 1.77 | 0.35 | 0.22 | 0.31 |
| | C.V | 1.30 | 1.12 | 1.07 | 1.57 | 3.34 | 4.32 | 1.29 | 1.71 | 3.94 | 3.72 |

- In terms of Test Weight maximum test weight recorded in V₆ variety (4.05 g) followed by the variety V₃ (3.42 g) and minimum test weight recorded in V₄ variety (2.41 g)

Test weight means thousand seed weight it varies with variety some have large seed some have small seed depend up on the size of seed weight also change [23-25]. The type of variety, difference in cropping season, type of soil and the type of management that can increase or decrease the available fertilizer efficiency. Similar results were observed by Datta [15] and Weiss [16].

Because of the relative optimum plant density in comparison to low seed rate and high seed rate treatment. In a study by Singh et al. [18], seed rate of 10 kg/ha resulted the height mean seed yield and number of seed per capsule.

- In terms of TSS content The maximum TSS content recorded in V₆ variety (6.00 °Brix) followed by the variety V₃ (5.96 °Brix) and minimum TSS content recorded in V₄ variety (3.71 °Brix). TSS means the amount Total Soluble Solids present in fruits. Depend up on the type variety TSS content varies. The TSS content measures and includes the carbohydrates, proteins, fats, minerals and organic acids of the fruit
- In terms of Economics, the maximum Gross return, Net return and Benefit cost ratio was found in T₆ (Azad kolonji) variety that is Rs 372000, 279493.6 and 4.12 followed by the V₃ (Rajendra Shyama) variety Gross return Rs 343500, Net return Rs 251153.6 and Benefit cost ratio 3.81 and minimum Gross return Rs 201000, Net return Rs 108653.6 and Benefit cost ratio 2.23 was recorded in the variety V₄ (*Nigella sativa*).

4. CONCLUSION

The present investigation concluded that the Azad kolonji variety of black cumin was found best in terms of growth, yield and quality traits along with highest gross return, net return and benefit cost ratio.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Malhotra SK, Vashishtha BB. Response of *Nigella* Variety NRCSS AN 1 to Different Agrotechnique National Research Centre on Seed Spices, Ajmer - 305 206 Rajasthan, India; 2008.
2. Maryam Sadat, Salamati, Mohammad, Bagheri. The Study of the Relationship between Seed Yield and Yield Components on *Nigella sativa* Genotypes. 2014;9/1(2):97-103.
3. Miheretu Fufa. Correlation Study in Yield and Some Yield Components of Black Cumin (*Nigella sativa* L.) Landraces Evaluation at Southeastern Ethiopia; 2016. DOI: 10.4172/2329-8863.1000239
4. Muhammed, Sajjad, Abdul, Ghafoor. Evaluation of *Nigella sativa* L., for Genetic Variation and Ex-situ Conservation. 2010;42:2489-249.
5. Preeti Verma, Solanki RK, Abhay Dashora, Kakani. Genetic Variability and Correlation Analysis in (*Nigella sativa* L.) Assessed in south East Rajasthan, India. 2019;8(3): 1858-1864.
6. Dubey PN, Singh B, Mishra BK, Kant K, Solanki RK. *Nigella* (*Nigella sativa*): A high value seed spice with immense medicinal potential. 2016;86(8):967-979.
7. Fekadu, Gebretensar, Mengistu, Getinet, Alemaw. Black cumin varieties aden and dershaye; 2021. DOI: 10.13140/RG.2.2.20751.30882
8. Fufa M. Correlation studies in yield and some yield components of Black Cumin (*Nigella sativa* L.) Landraces Evaluated at Southeastern Ethiopia. 2016; 4:239. DOI: 10.4172/2329- 8863.1000239
9. Gezahegn, Assefa, Sintayehu, Girma. Evaluation and Selection of Black Cumin (*Nigella sativa* L) Varieties at Mid Highland of West Hararge Zone, Eastern Ethiopia Journal of Biology, Agriculture and Healthcare; 2016. ISSN 2224-3208.
10. Jamin AR, Chattopadhyay N, Momin MC. Effect of biofertilizer with various levels of inorganic nutrients on growth and yield of black cumin (*Nigella sativa*): var; 2021.
11. Haq MZ, Hossain MM, Haque MM, Das MR, Huda MS. Blossoming characteristics in black cumin genotypes in relation seed yield influenced by sowing time. 2015; 6:1167-1183.

12. Shadia KA, Mallea EI, Aly AF. Effect of sowing dates on *Nigella sativa*. 1998;76(3): 1145-1156.
13. Sharangi AB, Roychowdhury A. Phenology and yield of coriander (*Coriandrum sativum* L.) at different sowing dates. 2014;9(2):33-42.
14. Naghera RP, Sukhadia NM, Ramani BB. Effect of sowing dates and varying levels of nitrogen and phosphorus on coriander (*Coriandrum sativum* L.). 2000;26(1):52-54.
15. Datta S, Sharangi AB, Pariari A, Chatterjee RR. Prospect of minor spices 196 cultivation in West Bengal. Paper presented in VIII State Science Congress, 28 Feb197 2nd–March, 2001, Kalyani Publisher, West Bengal, India; 2001.
16. Weiss EA. Spice Crops. CABI Publishing. CABI International, Wallingford, Oxon; 2002.
17. Luchon S, Sarat S. Black cumin (*Nigella sativa*) a new aromatic spicy medicinal plants. Proc. National Seminar on New perspectives in spices, medicinal and aromatic plants, ICAR Research Complex, Goa, India. November, 27-29, 2003;2003: 153.
18. Singh SK, Singh B, Singh MB, Singh B. Response of *Nigella* to seed rate and row spacing. 2002;2(1):80-81.
19. Sudhir SP, Alagappan Kumarappan, Jainendra Malakar, Verma HN. Genetic Diversity of *Nigella sativa* from Different Geographies Using RAPD. 2016;4(6):175-180.
20. Tigist Firew, Awlachew. Performance Evaluation of black cumin (*Nigella sativa* L.) Varieties at AlemKetema site, North Shewa, Ethiopia; 2017. DOI: 10.3390/nu13061784
21. Ved Kant, Meena SS, Meena NK, Lal G. Influence of Different Dates of Sowing, Fertilizer Level and Weedicides on Growth and Yield of *Nigella* (*Nigella sativa* L.) under Semi-Arid Conditions. 2018;7(9): 1156-1167.
22. Das AK, Sadhu MK, Som MK, Bose TK. Effect of spacing on growth and yield of black cumin. 1992;16(1):17-18.
23. Singh SP, Avinash Kumar, Banishidhar Sandeep, Kumar Suman, Ashutosh Kumar, Singh PP. Assessment of genetic Diversity in *Nigella* (*Nigella sativa* L.) collections using principle component analysis Dr. Rajendra Prasad Central Agriculture University, Pusa, Sumastipur, Bihar. 2019;848125.
24. Singh SP, Singh SP. Genetic Variability in *Nigella* (*Nigella sativa* L.); 2018. DOI: 10.15740/HAS/TAJH/13.1/32-35
25. Sen A, Khade SD, Jana J, Choudhury P. Effect of integrated nutrient management on growth, yield and quality attributes of black cumin (*Nigella sativa* L.) var. Rajendra Shyama Grown under Terai Region of West Bengal. 2019;28(1):61–65.

© 2022 Krishnan et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/90844>