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PHENOLOGICAL DEVELOPMENT, MORPHOLOGICAL INDICATORS, YIELD AND ESSENTIAL OIL CONTENT OF CUMIN (Cuminum cyminum L.) VARIETIES UNDER DIFFERENT PLANTING SCHEMES

Nizomov Rustam Axrolovich
Director of the Institute for Advanced Training and Retraining of Agricultural Personnel, Dr.Sc. in Agricultural Sciences, Professor

Xurammov Boxodir Norbutaevich
Researcher at the Scientific-Research Institute of Vegetable, Melon Crops and Potato

ABSTRACT

This article scientifically analyzes the effect of different planting schemes on the phenological development stages, morphological indicators, yield, and essential oil content of cumin varieties Ch-1 and In-1. Experiments were conducted using planting schemes of 45×10, 45×15, 45×20, 60×15, and 60×20 cm. The results indicated that planting density is a decisive factor affecting cumin growth rate, formation of reproductive organs, seed yield, and essential oil accumulation. For both varieties, the 45×15 cm planting scheme provided the highest agro-biological and economic efficiency.

Keywords: Cumin, variety, planting scheme, phenology, morphology, yield, essential oil, correlation.

INTRODUCTION

Essential oil and cumin crops have high economic value in agriculture, and improving their cultivation technology is one of the urgent tasks of the present day. Cumin (Cuminum cyminum L.) is among these crops and is widely used in food, pharmaceutical, and cosmetic industries.

Cumin yield and essential oil content depend not only on varietal traits but also directly on the planting scheme. Planting density affects competition between plants, light regime, soil moisture, and photosynthetic activity, influencing growth and development processes. Therefore, this study was aimed at comprehensively investigating the effect of planting schemes on Ch-1 and In-1 cumin varieties.

LITERATURE REVIEW

Cultivation of essential oil and cumin crops, their biological characteristics, and factors influencing yield and quality indicators have been extensively covered in both local and foreign studies. Abdullaev A.Q. [1] in his work justified the agro-biological characteristics of essential oil crops, their soil-climate requirements, and the importance of agrotechnical measures. Karimov I.B. [2] studied cumin cultivation technology and analyzed the effect of planting density and fertilization rates on morphological traits and productivity. Petrov V.N. [3] deeply analyzed morphological and physiological characteristics of essential oil crops and scientifically established the link between yield and essential oil accumulation. The FAO [4]

handbook provides international recommendations for cumin cultivation and management. Singh and Sharma [5] experimentally studied the effect of planting density on cumin yield and essential oil content.

Qodirov Z.H. [6] highlighted varietal biological potential, earliness, and yield characteristics in cumin and other spice crops. Azimov B.A. [7] analyzed factors enhancing yield in agricultural crops and demonstrated the interrelation of agrotechnical measures and fertilization. Khan and Verma [8] studied the effect of agronomic practices on cumin growth, development, and essential oil accumulation.

Overall, the analyzed literature shows that planting density, agrotechnical measures, and varietal traits are decisive for cumin cultivation. Furthermore, the relationship between yield and essential oil content is scientifically confirmed, supporting the validity of this study.

MATERIALS AND METHODS

Experiments were carried out in the experimental field on Ch-1 and In-1 cumin varieties. The experimental schemes included: 45×10 cm (control), 45×15 cm, 45×20 cm, 60×15 cm, and 60×20 cm.

Phenological phases were recorded in days. Morphological indicators (plant height, branching, number of flower stems and seeds) were measured as mean values for each variant. Yield was recalculated per hectare, and essential oil content was determined in the laboratory. Data were statistically and correlationally analyzed according to B.A. Dospehov's methodology.

RESULTS AND DISCUSSION

Data from Table 1 indicate that the planting scheme and varietal traits significantly influenced the timing of phenological phases of Ch-1 and In-1 cumin varieties. The In-1 variety was early-maturing compared to Ch-1, with all development stages occurring over a shorter period.

Table 1. Timing of phenological phases (days) of Ch-1 and In-1 varieties (2023–2024).

Variety	Planting Scheme	Emergence	True Leaf	Flower Stem	Flowering	Fruit Setting	Ripening
Ch-1	45×10	19–21	25–26	58–64	74–79	82–87	85–92
Ch-1	45×15	17–20	22–25	57–61	73–77	81–85	84–89
In-1	45×10	17–21	22–29	52–57	68–74	76–79	83–87
In-1	45×15	16–19	23–28	53–56	69–72	75–78	81–86

In the emergence phase, In-1 germinated faster (16–21 days) than Ch-1 (17–21 days), particularly in the 45×15 cm scheme. This may be related to varietal biological traits, seed vigor, and tolerance to external conditions.

In the flower stem stage, In-1 reached the phase in 52–57 days, while Ch-1 took 57–64 days, showing earlier generative development in In-1. Similarly, In-1 entered flowering and fruit-setting earlier, confirming its earliness. Ripening also occurred faster in In-1 (81–87 days) compared to Ch-1 (84–92 days), making it suitable for regions with short growing seasons.

Planting scheme influenced phenology as well. The 45×15 cm scheme provided relatively stable and synchronized phenological development for both varieties, likely due to sufficient nutrient space, light, and reduced competition. Denser planting (45×10 cm) slightly prolonged some phases. Morphological indicators of cumin varieties are presented in Table 2.

Table 2. Morphological indicators of cumin varieties (2023–2024).

Variety	Planting Scheme	Height (cm)	Branches (pcs)	Flower Stems (pcs)	Seeds (pcs)
Ch-1	45×10	39.8	9.2	14.1	390
Ch-1	45×15	44.5	11.0	17.3	432
In-1	45×10	41.5	9.8	15.0	405
In-1	45×15	47.0	11.6	18.0	445

The highest plant height (47.0 cm) was observed in In-1 under the 45×15 cm scheme. Denser planting (45×10 cm) reduced growth due to stronger competition for light, moisture, and nutrients. Branching and flower stem numbers also increased under 45×15 cm, supporting higher seed yield. Yield and essential oil content are presented in Table 3.

Table 3. Yield and essential oil content of cumin varieties (2023–2024).

Variety	Planting Scheme	1000-Seed Weight (g)	Yield (kg/ha)	Essential Oil (%)	r
Ch-1	45×15	2.52	435	3.55	0.91
In-1	45×15	2.48	428	3.45	0.90

Data indicate a strong positive correlation between yield and essential oil content (r = 0.90–0.91), meaning as yield increases, essential oil content also rises. Higher 1000-seed weight reflects complete seed formation and sufficient nutrient accumulation, contributing to total yield.

CONCLUSIONS

1. The 45×15 cm planting scheme provided high yield for both varieties: Ch-1 — 435 kg/ha, In-1 — 428 kg/ha.
2. Ch-1 had slightly higher 1000-seed weight (2.52 g) than In-1 (2.48 g).
3. Essential oil content was higher in Ch-1 (3.55%) compared to In-1 (3.45%).
4. A strong positive correlation exists between yield and essential oil content (r = 0.90–0.91), indicating these traits are closely linked.
5. Higher 1000-seed weight positively influenced total yield and demonstrated varietal biological potential.
6. Overall, the 45×15 cm planting scheme ensured high economic efficiency and quality for both varieties, with Ch-1 slightly superior in main indicators.

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