

STUDIES ON VARIABILITY, HERITABILITY AND CHARACTERS ASSOCIATION IN BLACK CUMIN (*NIGELLA SATIVA* L.)

SALEM, A. G., T.A. TAHA AND I. A. ABOU- EL-FADL

Horticultural Research Institute, Agricultural Research Centre, Egypt.

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Abstract

Variability, heritability and phenotypic correlation coefficient in the Local variety population of *Nigella sativa* were estimated.

The results reflected relatively moderate values of variability for most of the studied characters.

Heritability estimates of number of main branches per plant and capsules number per plant appeared to have high values, whereas those of earliness, plant height, herb weight per plant, seed weight per plant, crude and essential oil percentage were comparatively moderate.

Estimates of phenotypic correlation coefficient showed that earliness was positively correlated with each of number of main branches, herb weight, seed weight, capsules number and crude oil. There was a positive correlation between all previous characters. Other phenotypic correlation between the possible pairs of the characters were estimated.

INTRODUCTION

Nigella sativa L., which belongs to family Ranunculaceae is known as Nigella, Habat EL-Barka or Black cumin. It is considered as important medicinal crops in Egypt.

Nigella are widely distributed in countries which border the Mediterranean Sea, Central Europe and Western Asia (Hedrick, 1972).

Nigella plants (Seeds or oil) have a long history of folkloric medicine of various diseases. The seeds, on account of their aromatic nature, are used as a spice in cooking. They are also used as a carminative and diuretic (Hedrick, 1972). Plant breeders primarily estimate variability in initial population for its importance in choosing the most efficient breeding procedure. Elliot (1958) emphasized the fact that variation provides nature and plant breeder with the essential tool to develop new cultivars.

Agnihotri *et al.*, (1997), studied variability, correlation and path analysis in fennel (*Foeniculum vulgare*). They found that there was significant variability for days to flowering, plant height, branches per plant, umbels per plant, seed umbels, yield per plant

and yield per plot.

Baswana *et al.*, (1983) reported that yield per plant of cumin (*Cuminum cyminum* L.) had the highest genotypic and phenotypic coefficients of variation (23.41 and 24.17 % respectively) and heritability (93.83%).

Genetic variability in coriander (*Coriandrum sativum* L.) was studied by Sanker and Khader (1991). They mentioned that primary branches and umbels per plant recorded the highest genotypic coefficient of variation, heritability and genetic advance. Secondary umbel had the highest direct effect on yield and was thus considered the most significant feature for selection.

Datta and Biswas (1986) found that plant height, primary and total branches per plant and total capsules per plant in *Nigella sativa* exhibited positive and significant correlation among themselves and with seed yield.

The main purpose of this study was attempt to find the knowledge of association among characters of *Nigella sativa* plants and their relative magnitude which is considered very useful in planning breeding programs when selection is based on one or more characters.

MATERIALS AND METHODS

This investigation was carried out at Sabahia Horticultural Research Station, Alexandria during two seasons 1997/1998 and 1998/1999.

Nigella sativa L. plants were chosen for these experiments. It is an annual and winter herb.

The used seeds for the two years of experiments were obtained from the Medicinal and Aromatic Plants Research Station in EL-Kanater EL-Khairia, Egypt.

Seeds were sown (on October 9th) in both seasons in holes. The experimental field was divided into rows 70 cm wide and 4 m long spaces between holes were 40 cm. 3-4 seeds were put in every hole in a well prepared field. Fertilizers were applied at the recommended doses. All other cultural practices were done whenever they were required.

A population consisting of 1198 plants for estimation of value of range, mean, standard deviation, standard error and coefficient of variation for all characters under

investigation. Data were recorded on a number of individual plants taken at random for the following traits:

1. Earliness as number of days from planting till the first open flower.
2. Plant height in cm.
3. Number of main branches.
4. Herb weight.
5. Seed weight.
6. Number of capsules.
7. Crude oil percentage; the oil was extracted by a mechanical cold pressing of the seeds with a screw press machine (CARVER model 2759 S/N 2759-595 FREDS CARVER INC).
8. Essential oil percentage, was extracted by adding one ml of methanol to 1ml of crude oil (Fixed oil + Essential oil) in a glass centrifuge tube with cover. Vortex mix for 2 mins, the methanol top layer was transferred to a small glass vial. Laila *et al.*, (1995).

Heritability values in narrow sense were estimated as standard unit heritability as illustrated by Frey and Horner (1957).

The following formula was used to calculate the phenotypic correlation (r) among all possible combinations of the previously mentioned characters on the basis of individual plants taken at random.

$$r = \frac{M_{12}}{\sqrt{M_{11} \cdot M_{22}}}$$

M_{12} = Covariance of the two variable 1 and 2

M_{11} = variance of the first variable

M_{22} = Variance of the second variable.

RESULTS AND DISCUSSION

Variability estimation:

The results of variability in each of various studied characters in the original population of *Nigella sativa* are presented in Table (1). Considerable variation was noted

for herb weight per plant, capsules number per plant and seed weight per plant (C.V = 35.79, 28.11 and 24.53 respectively). This result noticed a continuous distribution in the segregation generations for these characters and might be related to the fact that the natural cross pollination in *Nigella sativa* is relatively high. Similar results were obtained by Shridar *et al.*, (1990), on coriander. They found that variability of fresh weight of plant, days to 50% flowering and seed yield per plant was significant. Sufficient variability existed among the tested population of *Nigella sativa* to suggest the possibility of increased yield through selection. The other studied characters showed relatively low variability.

Heritability estimations:

Data presented in Table (1) showed clearly that the estimated of heritability values of number of main branches per plant and capsules numbers per plant were relatively higher than those of other characters. The high heritabilities might be attained if the gene action involved was mostly additive. Such high heritability may suggest the efficiency when breeders select for these two characters, which is an easy to be practiced in the field, specially if there is a high amount of variability in the population.

Accordingly, these results indicate that those characters can be selected with high efficiency. Earliness, plant height, seed weight per plant and volatile oil percentage were also high values of their heritability.

Heritability values of herb weight per plant and crude oil percentage appeared to be relatively intermediate. These results seem to be somewhat high for a highly complicated character in its inheritance.

Bhandari *et al.*, (1991) found that the heritability estimates of coriander were high for days to flowering, moderate for plant height and number of primary branches and low for seed yield per plant. They mentioned that the days to flowering are considered the most significant feature for selection.

Phenotypic correlation among studied characters:

Phenotypic correlation (r) between possible pairs of the characters under investigation were estimated. The data are given in Table (2).

Earliness was moderate positively correlated with herb weight, number of branches, seed weight and capsules numbers, while it was low positively correlated with crude oil percentage. Plant height was found to be negatively correlated with earliness. Num-

ber of branches, herb weight and capsules number were all positively correlated with one another. These results agree with Datta and Biswas (1986) who found that primary and total branches of *Nigella sativa* and total capsules per plant exhibited positive correlation among themselves and with seed yield. The correlation between volatile oil percentage and each of characters; number of branches, herb weight, seed weight and capsules number was low rogations negative.

These results were in agreement with that reported by Sanjeev *et al.*, (1990); who found that correlation coefficient between volatile oil and seed yield of coriander, cumin and fennel was negative. The interrelationships among the minute chemical components and measured other characters may help and allow for more efficient selection. Thus, another objective of this study was to determine the type and magnitude of the phenotypic correlation among the studied characters, specially between volatile oil in seeds and each of the other studied characters.

Table 1. Estimation of variability* and heritability** of the studied characters in *Nigella sativa*.

Characters	Range	Mean \pm Standard Error $X \pm S_x$	Standard Deviation S	Coefficient of Variation C.V.	Heritability %
Number of days to first open flower (earliness)	138-195	160.54 \pm 2.24	15.81	9.85	80.96
Plant height in cm	71-124	93.76 \pm 1.55	10.99	11.72	89.25
Main branches/ plant	19-34	26.28 \pm 0.62	4.39	16.70	94.71
Herb weight/plant	100-400	225.5 \pm 11.42	80.71	35.79	79.63
Seed weight/ plant	21.7-77.1	50.64 \pm 1.76	12.42	24.53	85.95
Capsules No./ plant	115.3-325.8	202.43 \pm 8.05	56.90	28.11	90.48
Crude oil %	23.17-37.14	31.88 \pm 0.32	2.29	7.18	78.36
Volatile oil %	0.85-1.50	1.14 \pm 0.027	0.190	16.67	85.88

* Variability in the first season.

** Heritability in both seasons.

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دراسة الاختلافات ودرجة التوريث والارتباط بين الصفات الهامة فى نباتات حبه البركة (*Nigella sativa L.*)

أمل جابر سالم ، طه أحمد طه ، إبراهيم عبد الفتاح ابو الفضل

قسم بحوث النباتات الطبية والعطرية - معهد بحوث البساتين - مركز البحوث الزراعية

تم إجراء هذا البحث بمحطة بحوث بساتين الصبحية بالإسكندرية وذلك بغرض دراسة الاختلافات الموجودة فى نباتات حبه البركة للاستفادة منها أثناء إجراء الانتخاب للحصول على أصناف جديدة جيدة. كما قدر أيضا معامل الارتباط بين أزواج الصفات الذى يساعد فى تسهيل إجراء الانتخاب بالحقل على أساس الصفات المورفولوجية كما قدرت كذلك قيم معامل التوريث لهذه الصفات. وقد وجد مدى كبير فى الاختلافات فى معظم الصفات مما يتيح الفرصة لتحسينها كما لوحظ ان صفة التبيكير فى الأزهار ترتبط ارتباطا موجبا مع كل عدد الفروع ووزن النبات ووزن البذور وعدد الكبسولات والزيت الخام وكان ارتباط هذه الصفة سالبا مع ارتفاع النبات والنسبة المئوية والزيت الطيار.

أما وزن النبات ووزن البذور وعدد الكبسولات والنسبة المئوية للزيت الخام فقد وجد ان هناك ارتباطا موجبا فيما بينها .

وقد أضحت النتائج ان صفتى عدد الفروع وعدد الكبسولات للنبات كانت اعلى القيم بالنسبة لدرجة التوريث مما يدل على ان الانتخاب فيما بين هاتين الصفتين يكون ذا فاعلية وقد تفاوتت درجة التوريث فى بقية الصفات المدروسة.