Floral-biological Characteristics and Fruit Development of Fennel

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Abstract

On the basis of examinations the speed of flower development of two population of fennel (*Foeniculum vulgare* var. *subsp. capillaceum* var. *vulgare* ‘Soroksári’ and selected population of genebank origin ‘F86’) depends on species and regulated by range of umbels, mainly. The 6th and 7th phases of flowering, which are the most time consuming periods, need 7 or 8 days in case of the 1st range umbels, while only 5 or 6 days in 3rd range umbels. It was justified as well, that the germination power of seeds depends on maturity stage in which they were collected. Green seeds can be characterised by 40-60 % of germination, while this value increases up over 70 % if waxy and ripen seeds are tested. In harmony with literature data the essential oil content of fruits is the highest in „green seed” stage (5.83 ml/100g and 5.68 ml/100g in case of ‘F86’ and c.v. ‘Soroksári’, respectively).

INTRODUCTION

Nowadays, the demand for drugs of fennel (*Foeniculum vulgare* Mill.) of adequate quality is increasing. The optimisation of production is one of the preconditions to produce economical and stable crop. The widening the knowledge on floral-biology, including conditions of fertilisation seems to be an effective tool for improving the genetic background of the production.

In this respect cultivar of *Foeniculum vulgare* subsp. *capillaceum* var. *vulgare* ‘Soroksári’ and a selected population of genebank origin ‘F86’ were analysed on individual level.

MATERIALS AND METHODS

Plant Material

In the course of growing season of 2000 flowering dynamics of the c.v. ‘Soroksári’ and ‘F86’ populations were examined in 2-3 days intervals analysing the process of flowering paying attention to both internal and external parts of the main, 1st, 2nd, 3rd and 4th range umbels. There were 8 development phases of flowering distinguished by us in order to characterize the flowering processes, properly.

The stadiums, which were distinguished are as follows:

1. Green bud stadium,
2. Yellow bud stadium,
3. Petal opening,
4. Stamina opening, first pollens appear,
5. Pollen mass-production,
6. Stigma appearance,
7. Stigma elongation and ripening,
8. Flowering ceases, small green fruits form.

In order to characterise the fruit development processes fruits from 1st range umbels were taken and analysed, continuously. The sampling was conducted from the start of the fruit development (from the end of fertilisation) until the full ripening, in three different stage of ripening: “green seed” stage, “waxy seed” stage and “mature seed” stage.
Chemical Analysis

The essential oil was obtained from dried fruits by hydrodistillation in Clevenger apparatus according the method of Ph.Hg. VII (10 g fresh material in 400 ml water, during 1.5 h) and the oil yield was calculated to dry mass. The main components of the oil were analysed by capillary gas-chromatography (Shimadzu GC-B14 with Shimadzu Class – VP Chromatography Data System 4.2) equipped with FID. An SE-30 30 mm x 0.25 mm column was used (film thickness 0.25 µm). The injector and detector temperatures were 220°C and 250°C, respectively. Column temperature program: 90 °C (3 min.), 90-180 °C (6 °C/min), 180 °C (5 min.). Carrier gas was nitrogen, 1 ml/min at the starting temperature, 0.2 µl of essential oil of each samples were injected.

The compounds were identified by comparison of their retention times (tR) with those of pure substances, by peak enrichment with standards. Relative percentage of the oil constituents was calculated from the GC peak areas in percent of the total area.

RESULTS AND DISCUSSION

Under Hungarian conditions the total flowering period of 1st range umbels takes about 27-28 days, while only 22-23 days of that of the 3rd range umbels. The appearance of the stigma (6th phase), as well as stigma elongation and ripening (7th phase) can be characterised as the most time consuming periods. The period of the 6th and 7th phases needs 7 or 8 days in case of the 1st range umbels, while only 5 or 6 days at 3rd range umbels, which seems to be independent from origin of the population (Fig. 1 and Fig. 2). On the base of the results we concluded that the speed of development of individual flowers regulated on species level, mainly.

It is characteristic for the species too, that the total number of the lower rank umbels increases continuously, while their diameter, number of umbellets and number of individual flowers decrease, parallel.

We have justified that the germination power of fruits depends on maturity stage determined by time of the collection (Fig. 3). “Green seed” can be characterised by 40-60 % of germination, while this value increases up over 70 % if “waxy” and “ripen seeds” are tested. The essential oil content of fruits is the highest in green stage (5.83 ml/100g and 5.68 ml/100g in case of 'F86' and 'Soroksári', respectively) and it shows a decreasing tendency in case of waxy and ripen fruit stages (Fig. 4).

According to our investigation the anethole, methyl chavicol content shows an increasing tendency during the fruit development, while the fenchone, limonene, α-pinene and β-pinene content decrease. Population characteristics were found in changes of dry matter accumulation processes and thousand seeds (fruit) mass during the ripening phases (Fig. 5)

CONCLUSIONS

Under Hungarian conditions the total flowering period of individual umbels takes about 22-28 days and the appearance of the stigma (6th phase), as well as stigma elongation and ripening (7th phase) can be characterised as the most time consuming periods. The speed of development of lower rank umbels is accelerated, which seems to be an independent phenomenon from origin of the population and considered to be a species characteristics.

We have justified as well, that both germination power and essential oil content of the fruits depend on ripening stage, in which they were collected. It is in harmony with earlier literature data (Kattáá, 1996, Bernáth et al., 1999).

According to our investigation the anethole, methyl chavicol content shows an increasing tendency during the fruit development, while the fenchone, limonene, α-pinene and β-pinene content decrease. These results are only partially identical with the literature data, which can be explained by differences due to the large intraspecific variations occur in the taxa.
ACKNOWLEDGEMENTS
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Literature Cited


Figures

Fig. 1. Flowering dynamics of the ‘Soroksári’ and ‘F86’ populations – 1st range umbels (see the notes of Fig. 2.)
Fig. 2. Flowering dynamics of the ‘Soroksári’ and ‘F86’ populations - 3rd range umbels

Fig. 3. Essential oil content during the fruit development

Fig. 4. Changes of germination rate during the fruit development

Fig. 5. Changes of dry matter and thousand seed mass during the fruit development