Seed propagated tassel hyacinth: Effects of sites and sowing dates

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Abstract
Tassel hyacinth [*Muscari comosum* (L.) Mill.] is a spontaneous perennial bulbous plant of the Mediterranean area. The bulbs are widely used for food and represent a typical commodity, with a high historical and cultural heritage, especially for some Southern Italian Regions. In Italy, bulbs are commonly imported from North African countries, where they are still collected from the wild, to supply the fresh market and processing industry. In order to limit the massive import of a foreign product, there is a need to define a tassel hyacinth cultivation protocol that is self-sustainable and able to provide an adequate production of domestic bulbs. However, economically sustainable tassel hyacinth cultivation in Southern Italy requires the development of a suitable propagation modality, since bulb growth is very slow and it normally takes 3-4 years for bulbs to reach a marketable size. Therefore, this study examines results of research conducted on the gamic propagation of tassel hyacinth. Seed propagation trials were carried out from October 2008 to March 2009, with 6 sowing dates each delayed one month from the other, in two different localities of the Basilicata Region (S. Italy): the first, in the Metaponto plain (15 m a.s.l.) beside the Ionian Sea, and the second in a mountainous zone of Vaglio Basilicata (850 m a.s.l.). Seeds, collected from wild plants in the previous summer, were placed in hole containers in soil and were kept in open field conditions. Emergence dates and seedling numbers were recorded and at the end of the trials (plant senescence), bulblet weight and dimensions were recorded. Seed propagation results, in both Basilicata Region localities, showed better performances with the early sowings of October and November, due to a high seedling emergence percentage (from 92% to 100%) and uniformity. The delay in sowing caused a significant reduction in emergence that became zero with sowings in February and March.

Background
The name of the genus *Muscari* derives from the Arabic word ‘*muscarimi*’, which in turn originates from the Greek word ‘*moschos*’ referring to the fragrance emitted by certain species. The specimen word “*comosum*” refers to the apical tuff of sterile
flowers. The species grows from sea level up to an altitude of 2000 m. It is a widespread plant characterized by Eurimediterranean chorotype, but its area of distribution extends from south-western central Europe and Northern Africa to southern Russia and eastwards to Iran and Arabia. In England and elsewhere it is naturalized.

Tassel hyacinth [Muscari comosum (L.) Mill.] is a perennial, bulbous plant with linear leaves 5-15 mm wide, with a central channel. The flower stem which is formed in April to May is 20-60 cm tall. The fertile flowers are globose-urceolate, blue-brownish with pale yellowish-brown teeth and short tepal lobes; the uppermost flowers (‘tassel’) are sterile, with long stalks, closed and purple or electric-blue brightly coloured.

Ecologically and biologically, the species is a wild and semi-domesticated rustic, bulbous plant. As a biological form, it is situated in the geophyte plants class, having underground structures of storage (bulbs) which allow the plant to survive in conditions of dry/heat and cold stress [1]. In regard to seed dispersal, it is described as rain ballists and anthropochorous [2], while overall the available information on germination and reproductive biology are scarce [3-4].

The use of the bulbs has a long tradition in Southern Italy, Greece, the Near East, and the Eastern Mediterranean. Theophrastus [5-6] (4th century BC) refers numerous times to M. comosum (Historia Plantarum and De Causis Plantarum), known as ‘bulbs’, which is still today the current vernacular name of the plant in Greece. The plant has been described and is considered an important food source [7]. In Southern Italy, the tradition of its specific use as a food has been recorded in many ethnobotanical surveys; in particular in Sardinia [8], Sicily [9], Basilicata [10-11] and Apulia [12]. The bulbs are collected (and eaten) before the formation of the flowering stem, while the bulb is still rich in nutrients. Knowledge pertaining to the use of M. comosum as a medicinal plant is present in the Albanian communities in the Basilicata Region [13-14]. Furthermore, nutraceutical properties have been attributed to the presence of antioxidant compounds in the edible portion [15]. In Italy bulbs are commonly imported from North African countries, where they are still collected from the wild, to supply the fresh market and processing industry that, usually, preserve the bulbs in oil and sometimes in vinegar after blanching [16]. For tassel hyacinth cultivation in Southern Italy to be economically sustainable there is a need to consider the development of a suitable propagation modality, since bulb growth is very slow and it normally takes 3-4 years for bulbs to reach a marketable size [16]. Therefore, this study deals with research conducted on the gamic propagation of tassel hyacinth.

**Materials and Methods**

The study was conducted from October 2008 to March 2009 and involved tassel hyacinth gamic propagation trials in open field conditions. In July 2008, stems bearing the capsules containing mature seeds were collected from wild M. comosum plants in an uncultivated area of Vaglio Basilicata (40°40' N, 15°55' E, 850 m a.s.l., Basilicata Region, Southern Italy). Stems were dried and seeds were manually extracted from capsules and cleaned.

From 17th October 2008 to March 17th 2009, in two different locations of the
Basilicata Region: 1. Metaponto flat land (40°23' N; 16°47’ E, 15 m a.s.l.) beside the Ionian sea, and 2. In a mountainous zone of Vaglio Basilicata, seeds were sown consecutively at one month intervals, for six months in containers having 60 positions.

Seeds were sown in a medium-loamy-sandy soil, which originated from the same area where the seeds were collected and five seeds were placed in each position. In each of the two locations (environments), the six experimental theses (sowing dates) were distributed in the field according to a randomized block scheme, with three replicates.

After the onset of seedling emergence, data were recorded twice a week in order to evaluate the following parameters:

a) percentage of emerged plantlets = (number of emerged plantlets/number of seeds) * 100;

b) start of emergence, days (d) from the sowing date;

c) mean emergence time (MET) = Σ (n * d) / N1 where: n = total number of emerged plantlets recorded in each relief; d = number of days from the beginning of the trial; N1 = total number of emerged plantlets;

d) precocity of emergence ('T50') = number of days, starting from the sowing date, necessary to obtain 50% of the total emergence (cumulative).

Following complete leaf senescence of plants (late May - early June 2009), bulblets were extracted from the soil and then cleaned and dried before measuring of morphological traits (average weight and diameter). These parameters were measured on samples of 10 bulblets per each plot.

All collected data was subjected to analysis of variance (ANOVA), mean values were tested for statistically significant differences using Student–Newman–Keuls (SNK) test for main effects, and using the least significant difference (LSD) for interactions.

**Results**

At both locations the emergence of seedlings was observed following the first four sowings (October to January) (Figure 1), whilst the sowings in February and March resulted in a complete lack of seedling emergence. The cumulative emergence (Table 1) was different at the two locations (different environments) and it also varied significantly with sowing dates.

At Metaponto seedling emergence as an average of the four sowing dates was 84%, and was almost 9% higher than the mean value for seedling emergence at Vaglio Basilicata. Significant differences were also observed between the two locations (environments) with respect to other parameters associated with seedling emergence (early, average and precocity). In particular, seed emergence began at Metaponto 27 days earlier than at Vaglio Basilicata and the MET (17 days) and T50 (26 days) were lower (ie were reached in a shorter time) than at Vaglio Basilicata (Table 1).

Considering the effects of sowing date on seedling emergence, its cumulative percentage was, on average 89% for October, November and December, but declined to 51% for January. The number of days before the start of seedling emergence gradually declined with the delay of sowing, from 122 to 68 d, going from the first to the fourth sowing date. Later sowing also resulted in a faster and more
uniform emergence of seedlings as shown by lower values of MET and T50 in January. In fact, for the above parameters the observed values were, respectively, 82 and 80 d for sowing in January, and 140 and 139 d for sowing in October.

The analysis of the interaction "Location * Date of sowing" showed that the cumulative seedling emergence was significantly different between the two locations (environments) only with the sowing in December, with a higher percentage in Metaponto. Moreover, for the first three sowings seedling emergence started much earlier (between 31 and 45 d) at Metaponto, with respect to Vaglio Basilicata, whilst in January this difference between the two locations was only 19 d (Table 1). MET for the first three sowings was significantly more prolonged in Vaglio Basilicata, especially with the first sowing, while showed similar values between the two environments with respect to the fourth sowing. An almost similar trend was observed for T50 with significant differences even in the January sowing. The more precocious seedling emergence observed in Metaponto was more marked in the first sowing.

Bulblets average weight and diameter were found to be influenced both by the locations and by the time of sowing (Table 1). In particular, in Metaponto bulblet average weight (0.7 g) and diameter (5.2 mm) were significantly higher than the respective values (0.4 g and 4.1 mm) of bulblets in Vaglio Basilicata. The delay in sowing led to a gradual reduction in bulblet average weight and diameter; in fact, from the first to the fourth sowing, the first parameter varied from 0.7 to 0.3 g, and the second one, from 5.3 to 3.9 mm.

Considering the interactive effect "Location * Date of sowing", it should be noted that at Vaglio Basilicata the average bulblet weight was unchanged in the first three sowings, and decreased significantly only in the January sowing. On the contrary, at Metaponto a reduction of the average bulblet weight was observed already in the second sowing (November) with significant differences between the ages of the plants.

**Discussion**

Results obtained in this study contribute to understanding the effects of location and sowing date on the propagation of *M. comosum*, such information may constitute the basis for the cultivation of this bulbous plant.

The observations from the study carried out in two areas of the Basilicata Region showed that sowing can start from mid-October but cannot go beyond mid-January. In fact, sowing in mid-February and March resulted in no seedling emergence, while plants sown in January had a reduction in the percentage of emergence, approximately of 50% compared to that recorded with the sowings of the three previous months. This occurred both at Metaponto and in Vaglio Basilicata, areas having significantly different weather characteristics. The coastal environment of Metaponto is characterized by a milder climate and there, better seedling emergence levels were observed, especially, in the sowings of October, November and December when the average values were around 95%. Moreover, at Metaponto seedling emergence began almost a month ahead of that at Vaglio Basilicata and it showed a MET and T50 of about 18 d less than at Vaglio Basilicata. This resulted in an earlier start and a prolongation of the growth cycle, with a corresponding
production of larger bulblets. Moreover, at Metaponto sowing in mid-October, despite having made the emergence more continuous, allowed bulblets to reach a weight of up to 1 g, although this steadily decreased with the delay of sowing. In contrast, at Vaglio Basilicata, the bulblets growth was found to be almost unaffected by the time of sowing.

In conclusion, tassel hyacinth gamic propagation, while requiring a longer time than asexual propagation, allows the production of large quantities of bulblets thanks to the high germinative power and easy finding and/or production of the seed. However, it may be appropriate to test the effectiveness of some germinal treatments to allow a faster emergence of seedlings in order to ensure a greater enlargement of bulblets in the first growing season.

References

Arbe`reshe` of the Vulture area in southern Italy. *J. of Ethnopharmacology* 2002, **81**:165-185.


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**Figure 1.** Course of *Muscari comosum* seedlings emergence in the two localities of research Vaglio Basilicata and Metaponto as affected by sowing dates. The bars of each line indicate the standard error of the mean.
Table 1. Plantlets emergence and bulblet traits as affected by locality and sowing date.

<table>
<thead>
<tr>
<th>TREATMENTS</th>
<th>SEEDLINGS</th>
<th>EMERGENCE</th>
<th>BULBLETS</th>
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<tr>
<td></td>
<td>Cumulative (%)</td>
<td>Starting (d)</td>
<td>Mean emergence time (MET) (d)</td>
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<td></td>
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<tr>
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<td>83.5 A</td>
<td>75.9 B</td>
<td>96.4 B</td>
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<td>Vaglio Basilicata</td>
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<td>110.3 A</td>
<td>121.2 A</td>
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<td>121.8 A</td>
<td>140.2 A</td>
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<td>17/12/2008</td>
<td>87.0 A</td>
<td>85.3 C</td>
<td>95.0 C</td>
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<td>68.0 D</td>
<td>81.9 D</td>
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<td></td>
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<td>4.6</td>
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(1) Values in the columns having no letters in common are significantly different at P< 0.01 according to the SNK test.
(2) LSD = Least significant difference.