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Effect of Separate Level Versus Collective Seed Harvest on Seed Parameters of *Ammi majus* L.

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Abstract
The harvest time is one of the most important phase of the agricultural field as it marks the time when the crops are ready to be gathered. Economic and marketing issues are more important than considerations of maturity in deciding when to harvest a crop. Ammi majus L., a member of family Apiaceae, is one of the important medicinal plant that has great curative and preventive potential. The flowering of Ammi majus L. does not occur simultaneously in the complex inflorescence, so the fruiting umbels do not mature simultaneously. For best alkaloid content yield it has been suggested to harvest seeds when they are greenish brown. Any delay in harvesting results in loss of yield due to shattering. If harvesting is done at one mid time, both mature and immature seeds are collected together. This affects the quality of yield and various parameters of seed and seedlings. Hence an experiment was conducted to study seed yield, seed and seedling characters of variously harvested yield. For fruit and seed set in A. majus, umbels of different levels were hand-picked and harvested separately from primary, secondary and tertiary levels. For the sake of comparison seeds were also harvested collectively from the plant. The results have exhibited significant difference in seed set and the seed yield per level of umbels. The seed harvesting was done at 4 different maturity levels of inflorescence separately: T1, T2, T3, and T4. T1 -primary umbels, T2- secondary umbels, T3 –tertiary umbels and T4 –collectively from the entire inflorescence. It was found that different harvest techniques significantly affect seed viability, germination and survival percentage of Ammi majus L. and of the four techniques, T1 (seeds harvested from primary level umbels) was found most effective in terms of yield, seed and seedling characters and T3 (seeds harvested from tertiary level umbels) was found least effective.
Key Words: Ammi majus L., Apiaceae, Shattering, Viability and Survival percentage.

INTRODUCTION

Ammi majus L., a member of family Apiaceae, is an important medicinal plant. Its common names are Aatrilal, Bishop's weed, Greater *Ammi*, False Queen Anne's lace, Bullwort, Lace flower and Honey flower.

It is a native of Nile Delta of Egypt and widely grown throughout the Mediterranean region, Abyssinia, Africa and some parts of Egypt. In India, it was first introduced in the Forest Research Institute, Dehradun, in 1955 through the efforts of UNESCO. Its cultivation was undertaken in Jammu by **Bradu and Atal in 1970**. Since then its experimental cultivation has been tried in several parts of the country including Jammu, Dehradun, Mumbai, Chennai, Delhi and Punjab.

Ammi majus L. is known for its high coumarin content, particularly furanocoumarins. Coumarin, umbelliferone, bergapten, xanthotoxin, isopimpinellin, imperatorin and isoimperatorin have been reported from the plant (**Friedman et al., 1982, Wager & Bradt, 1996**). The drug has been the subject of a great deal of chemical and pharmacognostical investigations, due to utility of its active constituents in various ailments.

A. majus L. is regarded as the richest, natural source of linear furanocoumarins called psoralens. These compounds are found mostly in the fruits of this species (**Nielsen 1964, 1970**). The psoralens are successfully applied in photochemotherapy of numerous dermatological diseases, e.g., in treating Vitiligo, Psoriasis, Mycosis fungoides, Atopic eczema, Pityriasis lichennoides, Urtricaria pigmentosa, Alopecia areata, and others.

Xanthotoxin is marketed under the trade name "Ox soralen" and used in "Suntan lotion". Meladinine is a by-product of *Ammi majus* processing, containing both xanthotoxin and imperatorin sold in various formulations increases pigmentation of normal skin and induces re-pigmentation in vitiligo.

A. majus L. is used as an emmenagogue, for the treatment of leprosy, kidney stones, and urinary tract infections (**Farnsworth, 2001**). As diuretic, expectorant and is also useful in jaundice (**Khan & Rahman, 1985 and Lal, 1977**). The seed of *A. majus* L. is contraceptive (**Bown, 1995**). This decoction is also used as a gargle in the treatment of toothache (**Bown, 1995**), asthma and angina (**Chevallier, 1996**). The root is chewed to give protection from strong sunlight. *A.majus* is also used in the florist trade to add a lacy delicate look to bouquets and is considered as a highly fashionable flower for cut flowers arrangements.

The time of harvest is one of the most important phases of the agricultural field as it marks the time when the crops are ready to be gathered. **Megha et al., (2010; 2012)**, has reported the effect of organic nutrients and different sowing periods on the growth and yield of *A. majus*. In the present investigation, the effect of separate level versus collective seed harvest on the seed parameters of the crop was determined. As Per **Panda (2004)** *A. majus* is mature and ready to be harvested by the end of April or the beginning of

May. Since the flowering does not occur at the same time, so the fruiting umbels do not mature simultaneously. For the best alkaloid content yield it has been suggested **(Sobti et al. 1978)** to harvest seeds when they are greenish brown. Any delay in harvesting results in loss of yield due to shattering. If harvesting is done at one mid time, both mature and immature seeds are collected together. This affects the quality of yield and various parameters of seed and seedlings. Hence, an experiment was conducted and seed yield, seed and seedling characters of variously harvested yield was detected **[Plate No. 1,2,3,4 and 5].**

The seed harvesting was done

T_1 –from primary umbels separately.

T_2 –from secondary umbels separately.

T_3 –from tertiary umbels separately.

T_4 –collectively from the entire plant.

MATERIAL AND METHODS

Experimental Site

The present experiment was carried out at a leased Farm field at Gorewada, Nagpur during 2011-2012.

Preparation and Layout of Experimental Design

Selected experimental site for present investigation has fine and well-drained soil. It was close to the source of irrigation. The soil was dug up to a depth of about 25cm and thoroughly pulverized. The surface of the bed was made fine and smooth. The standard agronomic practices were followed for raising the crop of *Ammi majus*. The experimental field was divided into 20 plots of $2m^2$. The field was divided into 4 blocks, each block having five plots. A randomized Block Design (RBD) plan was followed for the layout.

Seed material

Seed material for cultivation of *Ammi majus* L. was procured from the herbal garden of Hamdard University, New Delhi.

Harvest management

To study the status of fruit and seed set in *Ammi majus* umbels at different levels were hand-picked and harvested separately from primary, secondary and tertiary levels. For the sake of comparison seeds were also harvested collectively from the plant. The results have exhibited significant difference in seed set and the seed yield per level of umbels.

Seeds were harvested from primary level of umbels (T_1), secondary level of umbels (T_2), and tertiary level of umbels (T_3) and collectively from the entire inflorescence (T_4). A working sample from each treatment type was drawn. The working sample of seeds from each treatment type was placed in air tight Ziploc bags in replicate of four, each replicate constituted of 25 seeds and stored in cold storage, for a period of 6 months, the natural time period between harvest and germination. Seeds were tested for viability, germination and seedling survival as per the methodology mentioned below.

Seed Sterilizations

Working seed sample are 4 replicates for each treatment. Each replicate constituted of 25 seeds. Seeds are sterilized with 0.1% mercuric chloride washed thoroughly with distilled water prior to the experiment.

Seed Viability Test

For the study of seed viability, seed coats were removed from the presoaked seeds, and cotyledons were transferred to the freshly prepared 1%solution of 2, 3, 5, triphenyl tetrazolium chloride and kept in dark for a period of 4 hours. Cotyledons were taken out and rinsed 2-3 times with water. Seed stained pink were observed and taken to be viable and then viability % was calculated.

Seed Germination and Seedling Survival

Experiment constituted germinating 25 seeds in germination trays. In the experiment the substrate used is growth mixture. The trays were regularly moistened to ensure saturation throughout the germination tests. The germination percent was calculated at the end of two weeks and the seedling survival at the end of 4weeks' period.

RESULT AND DISCUSSION

On perusal of data presented in **Table - 1 and Figure - 1**, it is revealed that the maximum seed yield/ plant has been recorded from seed harvested separately from primary umbels (T_1) and minimum from tertiary umbels (T_3).

The seeds thus harvested were screened for their viability, germination and seedling viability. Viability of seeds have ranged from 40% (T_3) to 95% (T_1), germination percent has ranged from 24% (T_3) to 84% (T_1) and seedling survival has ranged from 16.5% (T_3) to 78% (T_1) in seeds harvested separately from primary level umbels by hand. The overall pattern of results regarding above mentioned parameters can be expressed as follows:

Variation in mean percent seed viability due different harvesting techniques

T_1 (95.000) > T_2 (71.500) > T_4 (64.830) > T_3 (40.000)

Variation in mean percent seed germination due different harvesting techniques

T_1 (84.000) > T_2 (67.000) > T_4 (57.173) > T_3 (24.000)

Variation in mean percent seedling survival due different harvesting techniques

T_1 (78.000) > T_2 (63.000) > T_4 (48.640) > T_3 (16.500)

While reviewing the literature, it was found that in most of the Apiaceae members, fruit and seed set is comparatively low. This has been attributed to many factors. **Flemion and Waterbury (1941)** found that low seed-set in *Anethum graveolens* was due to the attack of Lygus bug on the developing ovaries. As Per **Kho and Braak (1956)** and **Braak and Kho (1958)**, in addition to infestation by Lygus, due to lack of proper pollination, fertilization is reduced affecting the the seed-set in *Daucus carota*. **Gupta (1964)**

observed that in umbellifers the low seed-set is mainly due to insect infestation. The ratio of male, hermaphrodite and underdeveloped flowers varies in the umbels of different orders. **Braak and Kho (1958)** pointed out that the formation of male or hermaphrodite flowers is chiefly controlled by genetic factors but may sometimes be affected by the environment **(Sehgal, 1965)**.

The umbels of the first order show the maximum number of umbellets and maximum number of flowers per umbellet. There is a gradual reduction in the number of umbellets in each umbel, and flowers in each umbellet, in the umbels of progressively higher orders. There are two ovules (one above the other) in each locule, and usually the lower one develops into a seed while the upper one aborts. Rarely, however, the upper ovule may also develop up to the mature embryo sac stage. The maximum seed-set recorded was 51.8 per cent and 46.2 per cent in the umbels of the first and second order respectively, and it abruptly dropped to 6.1 per cent and 0.2 per cent in the umbels of the third and fourth order, respectively **(Kho and Braak, (1956); Braak and Kho,1958, Sehgal, 1965)**.

The maximum seed-set in *Ammi majus*, *Anethum graveolens*,*Coriandrum sativum*, *Cuminum cyminum*, *Daucuscarota*, *Foeniculum vulgare* and *Trachyspermum Ammi* is in the first order and it declines in the umbels of higher order. The factors responsible for the low seed set are male flowers, underdeveloped flowers and lack of pollination or fertilization **(Sehgal, 1965)**.

Seeds harvested from primary level umbels; secondary level umbels; tertiary level umbels and harvested collectively from the plant. They were tested for seed set, seed germination and seedling survival. The maximum seed-set recorded was 95 per cent and 71.5 per cent in the umbels of the primary and secondary order respectively, and it abruptly dropped to 40 per cent in the tertiary level of umbels. In case of collective harvest the seed set rate recorded was 64.830 percent. Seed germination and seedling survival also exhibited similar variations **[Table -1, and Fig. No -1]**.

The crop flowers in February. Flowering and maturity of seed is spread over a long period of two months. The primary umbels and the early maturing secondary umbels are the major contributors to yield. Since the flowering does not start at the same time, so the fruiting umbels do not mature simultaneously. The primary umbels are harvested first. These are hand-picked individually in the last week of April or first week of May. When most remaining umbels are about to mature (mature green stage), plants should be cut at the middle level and stacked in loose bundles till the fruits dry. The crop can be threshed manually **(Panda, 2004)**. Even if there is a little delay in harvesting it results in the shattering of the seed which is the main constraint in the commercial cultivation of the crop and the main reason for low yields in India. The primary umbels mature first within 35-45 days. These are harvested at an interval of 2-4 days. Later, the early appearing secondary umbels are harvested. Afterwards, the entire crop is harvested, stored for a couple of days and then threshed to separate the seeds **(Panda, 2004)**. Delay in harvesting results in the loss of yield through shedding of seeds by shattering in situ. **Sobti et al., (1978)** have studied the problem of shattering of fruits of *Ammi majus*. Planofix (NAA) at the concentration of 5ppm was applied at 2 stages, on the onset the initiation of flowering and second at the time of formation of fruits. This increased fruit yield by 66 percent. This is helpful in deciding a better harvesting strategy for harvesting *Ammi majus* **(Panda, 2004).**

The data reveals that seed harvesting should not be done collectively. At least primary level umbels and early secondary level umbels should be hand-picked and harvested separately and later secondary level onwards can be harvested together. Analysis of the data revealed that four different harvesting techniques investigated have significantly ($P = <0.001$) affected parameters of the crop. On pair wise multiple comparison (Fisher LSD Method) it was observed that there was significant difference present in between all other treatment groups respectively ($P<0.001$).

Multiple comparisons (ANOVA) revealed that the data is statistically significant with overall significance level ($P<0.001$) the differences in the mean values among the treatment groups parameters are greater than would be expected by chance. Least Significant Difference (LSD) values at 5% are calculated at 0.05 level of significance was found significant for all treatments types.

CONCLUSION

It can be concluded from the above experiment that separate and collective seed harvest significantly affect seed viability, germination and survival percentage of *Ammi majus* L. and of the four techniques, T_1 (seeds harvested from primary level umbels) was found most effective and T_3(seeds harvested from tertiary level umbels) was found least effective. The findings of the present investigation reaffirm that the seed harvest should be done separately for primary and secondary level umbellets, that are major contributors of good quality seed.

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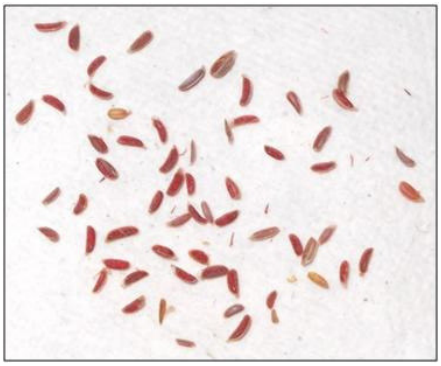
(1) *A. majus* L. Onset of Seed and Fruit Set

(2) *A. majus* L. Ripening Fruit of Primary Umbel

(3) *A. majus* L.: Harvested Fruit.

(4) *A. majus* L.: Harvested Seeds



(5) Viability Test of Seeds of *Ammi majus* L.

Table:1 - Effect of Harvest Techniques on Seed Viability, Germination and Seedling Survival of

Sl. No.	Treatments	Stats	Viability %	Germination %	Survival %
1.	T_1(Seeds harvested from primary level umbels)	$\bar{x}$	95.000	84.000	78.000
		S_D	2.000	3.266	2.828
		S_{ER}	1.000	1.633	1.414
2.	T_2(Seeds harvested from secondary level umbels)	$\bar{x}$	71.500	67.000	63.000
		S_D	3.416	2.582	2.582
		S_{ER}	1.708	1.291	1.291
3.	T_3(Seeds harvested from tertiary level umbels)	$\bar{x}$	40.000	24.000	16.500
		S_D	3.266	3.266	2.517
		S_{ER}	1.633	1.633	1.258
4.	T_4(Seeds harvested collectively from the plant)	$\bar{x}$	64.830	57.173	48.640
		S_D	3.546	2.584	6.809
		S_{ER}	1.773	1.292	3.404
5.	LSD at 5%		5.105	4.536	6.322

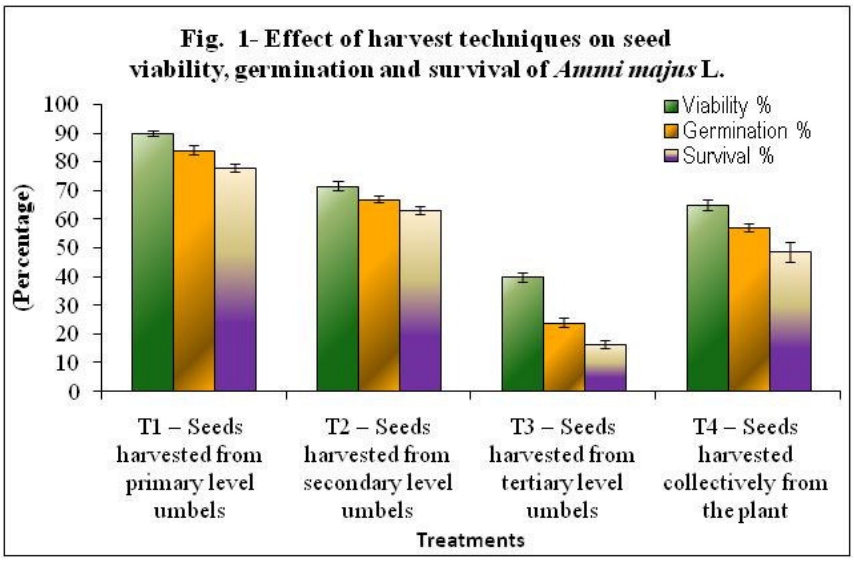


Fig. 1- Effect of harvest techniques on seed viability, germination and survival of *Ammi majus* L.

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