

GERMINATION OF *MATRICARIA MARITIMA* SUBSP.
INODORA (L.) DOSTAL (SCENTLESS MAYWEED)
ACHENES DEPENDING ON THEIR MATURITY
AND POSITION ON THE MOTHER PLANT

Magdalena Kucewicz, Czesław Hołdyński

Department of Botany and Nature Conservation
University of Warmia and Mazury
Plac Łódzki 1, 10-718 Olsztyn, Poland
e-mail: magdo@uwm.edu.pl

Accepted: May, 29, 2003

Abstract: In different plant species maternal factors influence the germinability of seeds. It can also be modified by environmental factors occurring during development and maturation. Achenes of *Matricaria maritima* subsp. *inodora* were collected in summer 1995. Some of seeds were tested under controlled conditions in autumn the same year. The other part of seeds was buried. After 6-month stratification in the soil, diaspores were tested under the same conditions as a sample examined in autumn. It was shown a difference in germination, which was dependent on stage of maturation seed, position of inflorescence on the mother plant and the position of seeds in inflorescence. It was observed that seeds germinated much better in autumn than diaspores stored in the soil during winter.

Key words: *Matricaria maritima* subsp. *inodora*, germination, seeds, capitulum, capitulum position on the maternal plant, capitulum stages of maturity

INTRODUCTION

The production of seeds that show different quality is a common phenomenon not only within homogenous populations, but also in the case of single plants (Baskin and Baskin 1998; Gutterman 1992; 1994; Thomas et al. 1978). Diaspores may differ as regards their morphological characters and anatomic structure, chemical composition, level of dormancy, physiological response to environmental factors affected by maternal variation, closely related to genetic and ecological variation (Górecki 1983; Grzesiuk and Kulka 1981).

Maternal variation results from different positions of seeds on the mother plant (Baskin and Baskin 1998; Grzesiuk and Kulka 1981; Gutterman 1992). In many plant species seed dormancy and germination were studied as affected by: (1) inflo-

rescence (infructescence) position on the mother plant (Gray 1979; Gutterman 1990; 1992; Jacobsohn and Globerson 1980; Thomas et al. 1979), (2) seed position in the inflorescence (infructescence) (Datta 1970; Evenari et al. 1977; Gutterman 1992; Raju and Ramaswamy 1983), (3) seed position in the fruit (Gutterman 1992; Maun and Payne 1989). It was found that the reasons for differential dormancy are non-simultaneous flowering and changing environmental influences (Fenner 1991; 1992; Gutterman 1992; Lityński 1982; Owczarow and Kizilowa 1966). The effects of the inflorescence position on the maternal plant and/or the seed position in the inflorescence on diaspore germination have been reported in numerous representatives of the *Asteraceae* family (Baskin and Baskin 1979; Evenari et al. 1977; Flint and Palmblad 1978; Gutterman 1980/81; Hoffman-Kąkol 1987; Koller and Roth 1964; Marks and Akosin 1984; Mc Donough 1975; Mc Evoy 1984; Tanowitz et al. 1987; van der Toorn and ten Hove 1982; Venable 1985). The physiological age of the parent plant at induction of the generative phase may also play an important role (Baskin and Baskin 1998; Kigel et al. 1979). According to Gutterman (1992) and Datta et al. (1972), the interaction between the seed position on the maternal plant and environmental factors modifies numerous morphological characters and differentiates seed responses to germination conditions, affecting future generations.

The aim of the present studies was to analyze the germinability of *Matricaria maritima* subsp. *inodora* seeds depending on the achene position on the mother plant and their maturity.

MATERIAL AND METHODS

The experimental materials were achenes and capitula of *M. maritima* subsp. *inodora* infesting the experimental plots of the Research-Experimental Station in Tomaszkowo near Olsztyn. Diaspores were collected at different stages of capitulum maturity, directly before crop harvest, in populations growing in spring barley and winter wheat (Aug 3, 1995), and horse bean and potatoes (Sept 13, 1995).

Before crop harvest, the inflorescences, flowers and achenes of scentless mayweed are at different stages of flowering, fruit setting and ripening. For the purpose of these studies, three stages of achene maturity were distinguished on the basis of easy to evaluate morphological characters of capitula:

stage I – petals of corollas of ray (ligulate) and disk (tubular) flowers well developed, in natural color, middle disk flowers in anthesis, peripheral disk flowers with a senescent corolla;

stage II – senescent ray flowers, bending down, the corolla of disk flowers turning brown, but firmly set on achenes;

stage III – fully mature capitula, dry and dark brown pedicels, the corolla of disk flowers falling off or no longer present, achenes falling off the capitulum (some capitula without achenes).

In order to determine the effects of the inflorescence position on the maternal plant and the achene position in the capitulum on the parameters of diaspore germination, scentless mayweed plants were collected at the stage of full maturity of all inflorescences (on August 19, 1995) from its population growing in maize. Plants with main stems (A) producing capitula on primary and secondary branches

(Fig. 1) were selected. Capitula are racemose inflorescences, with short, open out and flattened main axes. The flowering, setting and developing of seeds starts at the edge of the capitulum and continues towards its middle. In the capitulum achenes were divided, according to their position, into central, located in its upper part, and peripheral.

The 1000-seed weight was calculated according to the principles established by the ISTA (1999). Eight replications, 1000 seeds in each, were selected at random from pure seeds and weighed separately (grams). Then the variance, standard deviation and coefficient of variation were determined for the values obtained. If these coefficients did not exceed 4%, the replications were used for calculating the 1000-seed weight. If it was higher – another eight replications were selected and weighed, to determine the standard deviation for all sixteen ones. The replications differing from the mean more than the double standard deviation were eliminated, the other were used for calculating the 1000-seed weight.

The process of achene germination was carried out in a thermostat, at constant temperature $19 \pm 2^\circ\text{C}$, in Petri dishes, and wetted germination paper. The achenes were disinfected in a Pimafucin solution. Their germination energy was determined after four days of the test, and germination capacity – after nine days. The first germination test was conducted in autumn of the same year. The other seeds were put into nylon bags and buried in the soil at a depth of 20 cm, for six months. After stratification the germination tests were repeated in April.

The process of achene germination was carried out in a thermostat, at constant temperature $19 \pm 2^\circ\text{C}$, in Petri dishes, and wetted germination paper. The achenes were disinfected in a Pimafucin solution. Their germination energy was determined after four days of the test, and germination capacity – after nine days. The first germination test was conducted in autumn of the same year. The other seeds were put into nylon bags and buried in the soil at a depth of 20 cm, for six months. After stratification the germination tests were repeated in April.

RESULTS

Effect of achene maturity on their germination

Achenes collected at particular stages of maturity were characterized by a different moisture content and weight (Tab. 1). Seed developing manifested itself in a gradual decrease in the moisture content, accompanied by an increase in weight. Fully mature seeds (stage III), compared with achenes at stage I, contained by five times less water and were by ca. 26% heavier.

Seeds collected at various stages of maturity from populations growing in different crops (spring barley, horse bean, winter wheat, potatoes) were tested for germination in autumn of the same year and spring of the next year, after being stored in the soil from November to April (Tab. 2). The autumn tests showed that the germin-

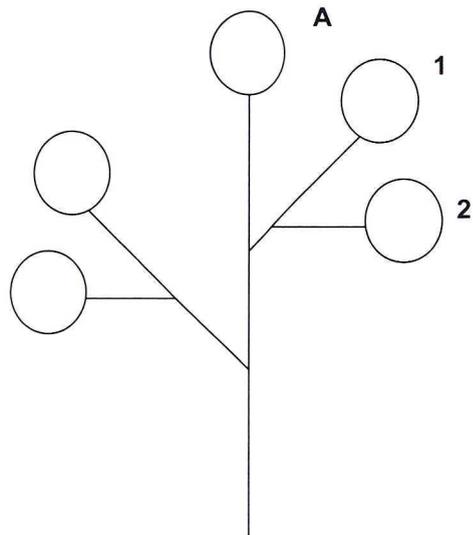


Fig. 1. A diagrammatic representation of the capitula of *Matricaria maritima* subsp. *inodora* plant: A – apical capitulum, 1 – capitulum on primary branches, 2 – capitulum on secondary branches

Table 1. Some of physiological properties of *Matricaria maritima* subsp. *inodora* achenes at different maturity stages

| | Stage of maturation* | | |
|----------------------|----------------------|-------|-------|
| | I | II | III |
| Moisture content (%) | 66 | 36 | 12.5 |
| 1000-seed weight (g) | 0.230 | 0.260 | 0.310 |

*explanations in "Material and Methods"

ability of scentless mayweed achenes was at a higher level than their morphological maturity (Tab. 2). The germination capacity of seeds at maturity stage I was 13% at the beginning of the test, and 20%–47% after nine days, depending on the origin of their population. The seeds collected from capitula at stage II usually germinated similarly to diaspores at stage III. At the beginning of the test their germinability varied from 5% to 41%, and was lower than that of fully mature diaspores (15%–60%), but finally achieved 19%–71%, being by only 8% lower than that of achenes collected at stage III. Fully mature diaspores germinated at a level of 63%–75% (an exception were seeds collected from plants growing in horse bean – 27%).

The germination test performed in spring, after seed storage in the soil, showed a decrease in the majority of germination parameters. The germination energy and capacity of achenes at maturity stage II and III reduced to ca. 30%. The soil hibernation was especially disadvantageous to the survival of the least developed diaspores (stage I). Achenes from the population growing in horse bean and winter wheat decayed, the other germinated at a level not exceeding 10%.

Table 2. Germination (%) of *Matricaria maritima* subsp. *inodora* achenes at different maturation stage of capitulum; diaspores were collected from populations growing in different crops

| Tested | Agrocenose | Maturation stage of capitulum* | | | | | |
|----------|---------------|--------------------------------|------|------|------|------|------|
| | | I | | II | | III | |
| | | a | b | a | b | a | b |
| 15.11.95 | Spring barley | 16.0 | 46.7 | 24.0 | 60.0 | 40.0 | 62.7 |
| | Horse bean | 16.0 | 28.0 | 5.3 | 18.7 | 14.7 | 26.7 |
| | Winter wheat | 4.0 | 20.0 | 21.3 | 46.7 | 57.3 | 65.3 |
| | Potato | 16.0 | 34.7 | 41.3 | 70.7 | 60.0 | 74.7 |
| | Mean | 13.0 | 32.4 | 23.0 | 49.0 | 43.0 | 57.3 |
| 25.04.96 | Spring barley | 4.0 | 6.7 | 16.0 | 26.7 | 8.0 | 37.3 |
| | Horse bean | 0.0 | 0.0 | 37.3 | 41.3 | 14.7 | 16.0 |
| | Winter wheat | 0.0 | 0.0 | 8.0 | 28.0 | 5.3 | 32.0 |
| | Potato | 5.3 | 9.3 | 25.3 | 30.7 | 22.7 | 29.3 |
| | Mean | 2.3 | 5.0 | 21.7 | 31.7 | 12.7 | 28.7 |

a – observation after 4 days

b – observation after 9 days

*explanations in "Material and Methods"

Effect of the achene position in the capitulum and on the maternal plant on their germination

The maternal variation of *M. maritima* subsp. *inodora* seeds manifests itself in inflorescence formation on branches and seed position in the capitulum. The maternal variation of achenes from capitula located on the main stem (A) and primary and secondary branches resulted in a significant decrease in the 1000-seed weight, from 0.33 g in the case of peripheral achenes in capitula on the main stem, to 0.16 g in that of central achenes in capitula on secondary branches (Fig. 2).

The autumn tests confirmed the influence of the sequence of inflorescence formation on achene germination (Fig. 3). The results obtained show that seeds from capitula on the main stem germinated at a similar level to those from capitula on primary branches. Achenes from capitula located on the main stem were the first to germinate (77%) and their germination capacity was the highest (83%); in achenes from capitula located on primary branches these values were 56% and 77% respectively. Achenes from inflorescences on secondary branches were characterized by the lowest germination capacity – 36% after four days and 59% after nine days. The autumn tests showed also that the position of seeds in the capitulum does not affect their germination.

The germination parameters decreased considerably after six-month seed incubation in the soil (Fig. 4). In spring these seeds started to germinate later than the other ones, and their germination capacity was reduced by ca. 50%. Seeds from inflorescences formed at a later stage (on primary and secondary branches) were characterized by worse germination parameters than those formed on the main stem. The germination capacity of the latter ones was in that period 43%, whereas

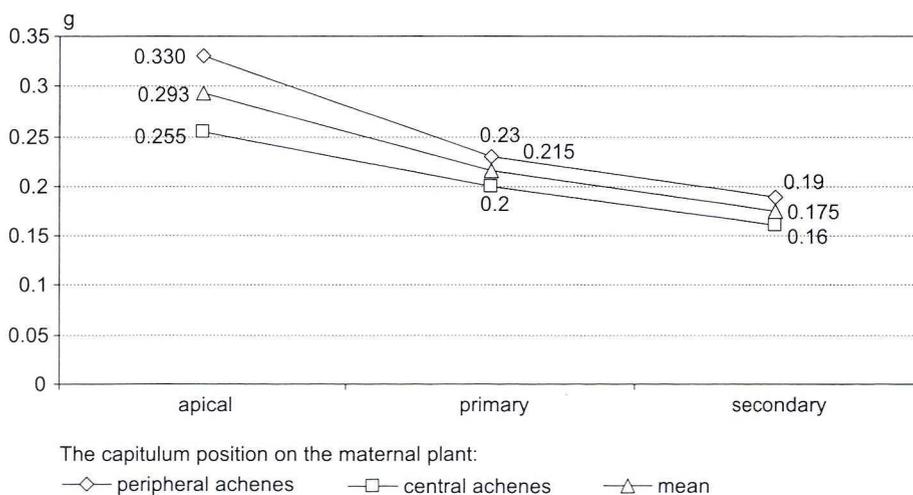


Fig. 2. Effect of capitulum position on the maternal plant (apical, primary, secondary) and achenes position in the capitulum (peripheral, central) on weight of 1000 seeds (g) of *Matricaria maritima* subsp. *inodora*

of the former ones – 30%. The germinability of peripheral achenes was on average by 7.5% lower, compared with central achenes.

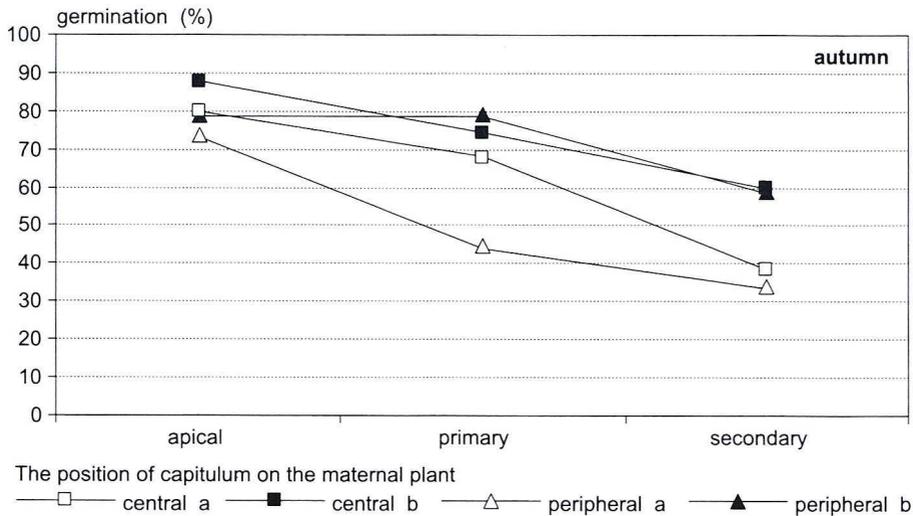


Fig. 3. Germination (%) of *Matricaria maritima* subsp. *inodora* achenes depending on its position on the maternal plant and in the capitulum; a) – observation after 4 days, b) – observation after 9 days

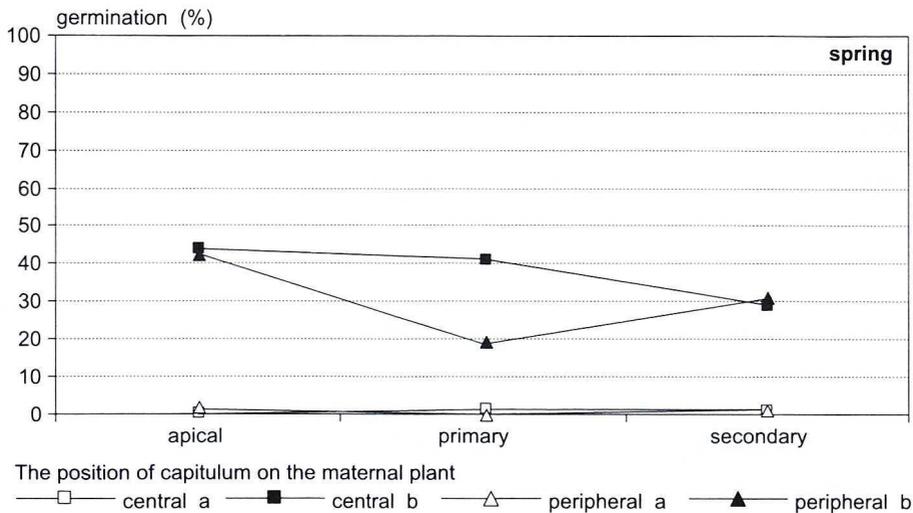


Fig. 4. Germination (%) of *Matricaria maritima* subsp. *inodora* achenes depending on its position on the maternal plant and in the capitulum; a) – observation after 4 days, b) – observation after 9 days

DISCUSSION

The results of our studies indicate that the sequence of seed development in the capitulum affects germination to a much lower degree than the position of capitula on the mother plant. The autumn tests showed that the germinability of peripheral (produced earlier) and central (produced later) achenes was similar. However, secondary dormancy of seeds from the oldest capitula (formed on the main stem) started at that time. At first this phenomenon concerned only peripheral achenes, later also central ones, becoming more intensive during seed incubation, which was confirmed by the spring tests. Studies on the effects of the position of *M. maritima* subsp. *inodora* seeds in the inflorescence on their germination were also conducted by Hoffman-Kąkol (1987) and Priestley (1986). They reported that the germination capacity of ray achenes (female) is three times lower than the germination capacity of disk achenes (hermaphrodite). Our observations show that differential dormancy of achenes is a dynamic process and concerns not only ray achenes, but also (in consequence of prolonged incubation) the other achenes in the capitulum.

However, it was impossible to determine the relationships between the maturity of diaspores of different species and their dormancy, because their responses change depending on the dormancy-regulating mechanisms. The correlation between the physiological and morphological maturity has been investigated in crop plants, including cereals (Grzesiuk and Rejowski 1960; Grzesiuk 1961; Sójka 1961; Rejowski 1962), Leguminosae (Grzesiuk and Sójka 1961; Sidhu and Cavers 1977), oil-bearing plants (Taran 1956; Wiązecka 1961; Wiązecka 1963) and vegetable plants (Szynalska 1963). Similarly as in many species of cultivable plants (Grzesiuk 1961), we observed ca. 30% germination capacity of the least developed diaspores of scentless mayweed. However, this concerns only this part of population, which goes directly from the maternal plant to the soil, immediately having good conditions for germination. It seems that achenes at maturity stage I do not constitute a soil bank capable of germinating. It was also (though indirectly) noted by Grzesiuk and Kulka (1981), who reported that morphologically immature seeds of uncultivated herbaceous plants are very rarely able to germinate.

Our findings demonstrate that more developed achenes of *M. maritima* subsp. *inodora* show better germination capacity. This phenomenon, observed also in many species from the *Brassicaceae* family (Grzesiuk and Kulka 1981; Hume 1984) and vegetable plants (Lityński et al. 1958), is connected with the fact that dried-up seed coats are no longer a barrier to germination. However, it would be difficult to compare the behavior of seeds representing different species, due to the specific character of their dormancy. Seeds of scentless mayweed are described in literature as nondormant (Baskin and Baskin 1998) and not requiring stubble-field ripening (Hoffman-Kąkol 1987). Nondormant seeds are probably the result of evolution of seeds with morphological dormancy, which used to increase their embryos at the cost of endosperms. The main reason for dormancy is underdeveloped nondormant embryos whose final growth takes place after sowing. This type of dormancy is typical first of all of tropical plants, but occasionally observed also in the *Asteraceae* (Baskin and Baskin 1998).

The spring tests did not confirm the results obtained by Hoffman-Kąkol (1987), which suggested the spring character of scentless mayweed, manifesting itself in an increase in the germination capacity at the beginning of winter (mid-December) and in spring (mid-April). These differences are connected with different seed storage over winter (in the experiment performed by Hoffman-Kąkol seeds were kept at a laboratory, at room temperature). It follows that germination of *M. maritima* subsp. *inodora* differs from the pattern characteristic of *Asteraceae* seeds, with the peak of seedling emergence in spring (Roberts and Neilson 1981). Our investigation shows that the optimum time for seedling emergence and the formation of leaf rosettes in scentless mayweed is the end of summer and autumn. This indicates that a facultative winter character of this plant.

The development and maturation of scentless mayweed seeds are accompanied by a gradual decrease in the moisture content (Tab. 2), which is typical of most seeds (Hay and Probert 1995). A low water content of diaspores is conducive to their good quality (Grzesiuk and Kulka 1981; Harrington 1972). However, our studies demonstrate that the lower the moisture content of *M. maritima* subsp. *inodora* achenes, the better their germination capacity. Grzesiuk and Kulka (1981) also noted this tendency in weeds, but did not give concrete names of species. They also observed that generally lower water content of diaspores is connected with deeper dormancy and slower metabolic processes.

CONCLUSIONS

1. Stratification in the soil for six months had a negative effect on the germination of scentless mayweed seeds. The germination energy of diaspores decreased in spring to 3.3% (compared with 58% in autumn) and their germination capacity – to 30% (69% in autumn). Better germination parameters achieved by achenes in autumn indicate a facultative winter character of this weed.
2. Before crop harvest the achenes of scentless mayweed are at different stages of maturity. The polymorphic seeds germinated depends on maturity. The least mature diaspores (stage I) germinated in autumn at a level of 20%–46%, but after incubation in the soil were hardly capable of emerging at all. Seems that achenes at maturity stage I do not constitute a soil bank capable of germinating. In autumn diaspores from capitula at maturity stage II and III germinated in autumn at a level of 47%–75%, except for those growing in horse bean (18%–27%); in spring – at a level of 16%–41%.
3. It was found that the position of inflorescences on the maternal plant affects germination. In autumn achenes from capitula located on the main stem and on primary branches were characterized by the best germination capacity (83%, 77%). In spring seeds started to germinate later than the other ones and their germination capacity reduced by 50%. Achenes from inflorescences on main stem were characterized by the best germination capacity (43%).
4. Our observation shows that differential dormancy of achenes from capitulum is a dynamic process and concerns not only ray achenes, but also the other achenes in the capitulum.

REFERENCES

- Baskin C.C., Baskin J.M. 1998. Seeds. Ecology, biogeography, and evolution of dormancy and germination. Academic Press, 666 pp.
- Baskin J.M., Baskin C.C. 1979. Studies on the autecology and population biology of the monocarpic perennial *Grindelia lanceolata*. Am. Midl. Nat., 102: 290–299.
- Datta S.C., Evenari M., Gutterman Y. 1970. The heteroblasty of *Aegilops ovata* L. Israel J. Bot., 19: 463–483.
- Datta S.C., Gutterman Y., Evenari M. 1972. The influence of the origin of the mother plant on yield and germination of their caryopses in *Aegilops ovata* L. Planta (Berl.) 105: 155–164.
- Evenari M., Kadouri A., Gutterman Y. 1977. Ecophysiological investigations on the amphicarp of *Emex spinosa* (L.) Campd. Flora 166: 223–238.
- Fenner M. 1991. The effects of the parent environment on seed germeability. Seed Sci. Res., 1: 75–84.
- Fenner M. 1992. Environmental influences on seed size and composition. Hort. Rev., 13: 183–213.
- Flint S.D., Palmblad I.G. 1978. Germination dimorphism and developmental flexibility in the ruderal weed *Heterotheca grandiflora*. Oecologia 36: 33–43.
- Górecki R.J. 1983. Przyczyny zmienności fizjologicznych właściwości nasion. Zesz. Probl. Post. Nauk Roln., 258: 61–73.
- Gray D. 1979. The germination response to temperature of carrot seeds from different umbels and times of harvest of the seed crop. Seed Sci Technol., 7: 169–178.
- Grzesiuk S. 1961. O fizjologicznych właściwościach rozwoju nasion. Wiad. Bot., 5 (1): 3–18.
- Grzesiuk S., Kulka K. 1981. Fizjologia i biochemia nasion. PWRiL, Warszawa.
- Grzesiuk S., Rejowski A. 1960. Studia nad fizjologią dojrzewającego ziarna kukurydzy zwykłej (*Zea mays* L. ssp. *indurata*). Roczn. Nauk. Roln., 81-A(1): 137–175.
- Grzesiuk S., Sójka E. 1961. Studia nad fizjologią dojrzewających nasion bobiku (*Vicia faba* L. ssp. *Minor*), Roczn. Nauk. Roln., 83-A(4): 735–770.
- Gutterman Y. 1980/81. Review: Influences on seed germinability: phenotypic maternal effects during seed maturation. Control Mechanism. p. 93–97. In “Seed Germination” (A.M Mayer, ed.). Weizmann Science Press of Israel, Jerusalem, Israel. Israel J. Bot. 29.
- Gutterman Y. 1990. Do the germination mechanism differ in plants originating in deserts receiving winter or summer rain? p. 355–372. In “Special edition in memory of the late Professor M. Evenari” (A.M. Mayer, ed.). Israel J. Bot. 39.
- Gutterman Y. 1992. Maternal effects on seeds during development. p. 27–59. In “Seeds. The ecology of regeneration in plant communities”. (M. Fenner, ed.). C.A.B. International, U.K.:
- Gutterman Y. 1994. Germinability under natural temperatures of *Lactuca serriola* L. achenes matured and collected on different dates from a natural population in the Negev Desert highlands. J. Arid Environ., 28: 117–128.
- Harrington J.F. 1972. Seed storage and longevity. p. 145–245. In: „Seed Biology” (T.T. Kozłowski, ed.). Academic Press, New York.
- Hay F.R., Probert R.J. 1995. Seed maturity and the effects of different drying conditions on desiccation tolerance and seed longevity in foxglove (*Digitalis purpurea* L.). Ann. Bot., 76: 639–647.
- Hoffman-Kąkol I. 1987. Niektóre właściwości biologiczne maruny bezwonnej *Tripleurospermum inodorum* (L.) Schultz – Bip. Zesz. Nauk. AR Szczecin 131: 13–32.

- Hume L. 1984. The effect of seed maturity, storage on the soil surface, and burial on seeds of *Thlaspi arvense* L. Can. J. Plant Sci., 64: 961–969.
- ISTA 1999. Preceedings of the International Seed Testing Association. International rules for seed testing. Seed Sci. & Technol., Vol. 27, Supl.: 1–333.
- Jacobsohn, R., Globerson, D. 1980. *Daucus carota* (carrot) seed quality: I. Effects of size on germination, emergence and plant growth under subtropical conditions. II. The importance of the primary umbel in carrot-seed production. p. 637–646. In: „Seed Production” (P. D. Hebblethwaite, ed.). Butterworths, London/Boston:
- Kigel J., Gibly A., Negbi M. 1979. Seed germination in *Amaranthus retroflexus* L. as affected by the photoperiod and age during flower induction of the parent plants. J. Exp. Bot., 30: 997–1002.
- Koller D., Roth N. 1964. Studies on the ecological and physiological significance of amphicarp in *Gymnarrhena micrantha* (Compositae). Am. J. Bot., 51: 26–35.
- Lityński M. 1982. Biologiczne podstawy nasiennictwa. PWN, Warszawa, 487 pp.
- Lityński M., Buczak E., Chudoba Z. 1958. Obserwacje nad wtórnym dojrzewaniem nasion roślin warzywnych. Biul. IHAR 6: 3–18.
- Marks M.K., Akosin C. 1984. Achene dimorphism and germination in three composite weeds. Trop. Agric., 61: 69–73.
- Maun M.A., Payne A.M. 1989. Fruit and seed polymorphism and its relation to seedling growth in the genus *Cakile*. Can. J. Bot., 67: 2743–2750.
- Mc Donough W.T. 1975. Germination polymorphism in *Grindelia squarrosa* (Pursh) Dunal. Northw. Sci., 49: 190–200.
- Mc Evoy P.B. 1984. Dormancy and dispersal in dimorphic achenes of tansy ragwort, *Senecio jacobaea* L. (Compositae). Oecologia 61: 160–168.
- Owczarow K.E., Kizilowa E.G. 1966. Raznokacastwiennost' siemjan i produktiwnost' rastienij. Izd. Kolos, Moskwa.
- Priestley D.A. 1986. Seed aging. Implications for seed storage and persistence in the soil. Comstock Publishing Associates, Ithaca, 304 pp.
- Raju M.V.S., Ramaswamy S.N. 1983. Studies on the inflorescence of wild oats (*Avena fatua*). Can. J. Bot. 61: 74–78.
- Rejowski A. 1962. Fizjologia i biochemia dojrzewającego ziarna pszenicy. I. Morfologia rozwoju oraz fizjologiczne właściwości dojrzewającego ziarna. Roczn. Nauk Roln., 85 A–2: 293–306.
- Roberts H.A., Neilson J.E. 1981. Seed survival and pericocity of seedling emergence in twelve weedy species of *Compositae*. Ann. Appl. Biol., 97: 325–334.
- Sidhu S.S., Cavers P.B. 1977. Maturity-dormancy relationships in attached and detached seeds of *Medicago lupulina* L. (black medick). Bot. Gaz., 138: 174–182.
- Sójka E. 1961. Badania nad fizjologią i biochemią rozwijającego się ziarna żyta (*Secale cereale* L.). Cz. I. HRAN 5, 6, 689–703; Cz. II. Hran 5, 6: 705–720.
- Szynalska M. 1963. Wartość siewna poślednich nasion roślin baldaszkowatych. Biul. IHAR 1–2: 31–36.
- Tanovitz B.D., Salopek P.F., Mahall B.E. 1987. Differential germination of ray and disc achenes in *Hemizonia increscens* (Asteraceae). Am. J. Bot., 74: 303–312.
- Taran I. 1956. Sposobnost k porastaniju siemian popdsolnecznika w zawisimosti ot stepieni ich zrielosti. Bot. Žurn., 41, 11: 1656–1662.
- Thomas T.H., Gray D., Biddington N.L. 1978. The influence of the position of the seed on the mother plant on seed and seedling performance. Acta Hort., 83: 57–66.

- Thomas T.H., Biddington N.L., Otoole D.F. 1979. Relation-ship between position on the parent plant and dormancy characteristics of seeds of three cultivars of celery (*Apium graveolens*). *Physiol. Plant* 45: 492–496.
- Van Der Toorn J., Ten Hove H.J. 1982. On the ecology of *Cotula coronopifolia* L. and *Ranunculus sceleratus* L. II. Experiments on germination, seed longevity, and seedling survival. *Acta Oecol.*, 3: 409–418.
- Venable D.L. 1985. Ecology of achene dimorphism in *Heterotheca latifolia*. III. Consequences of varied water availability. *J. Ecol.*, 73: 757–763.
- Wiązecka K. 1961. Wpływ stopnia dojrzałości kilku odmian rzepaku ozimego na ich właściwości biologiczne i technologiczne. I. Właściwości biologiczne. *HRAN* 5: 414–443.
- Wiązecka K. 1963. Zagadnienie wpływu stopnia dojrzałości nasion roślin uprawnych na ich właściwości biologiczne. *Biul. IHAR* 1–2: 67–70.

POLISH SUMMARY

KIEŁKOWANIE NIEŁUPEK *MATRICARIA MARITIMA* SUBSP. *INODORA* (L.) DOSTAL W ZALEŻNOŚCI OD POŁOŻENIA MATERNALNEGO I STOPNIA DOJRZAŁOŚCI

Zmienność maternalna jest jedną z przyczyn powstawania zróżnicowanej jakościowo puli nasion. Niełupki *Matricaria maritima* poddano testom kiełkowania w dwóch terminach – jesienią, w roku zbioru oraz wiosną, po okresie 6-miesięcznej stratyfikacji w glebie. Jesienią zdolność kiełkowania niełupek maruny bezwonnej wynosiła średnio 69%, wiosną spadła do ok. 30%. Badania wykazały także zróżnicowanie kiełkowania w zależności od uzyskanego przez diaspory stopnia dojrzałości przed zbiorem rośliny uprawnej, w której maruna rosła i dojrzewała, położenia kwiatostanów na rozgałęzionych pędach oraz umieszczenia nasion w kwiatostanie. Diaspory najmłodsze (I faza) jesienią kiełkowały w ilości 20–46%, po przechowaniu w glebie okazały się niemal niezdolne do kiełkowania. Nasiona z koszyczków będących w II i III fazie dojrzałości jesienią kiełkowały na poziomie 47–75% (wyjątek – nasiona z bobiku – 18–27%), wiosną kiełkowały słabiej o 25–28%. Stwierdzono ponadto wpływ położenia kwiatostanu na roślinie oraz położenia nasion w kwiatostanie na parametry kiełkowania. Jesienią najlepiej kiełkowały nasiona z koszyczków pędu głównego i pierwszorzędowych, wiosną – z koszyczków pędu głównego. Przeprowadzone kiełkowanie niełupek w pełni dojrzałych, wg podziału na centralne i peryferyczne, wykazało, że różnicowanie spoczynku nasion w koszyczku jest procesem dynamicznym. W miarę przedłużającego się przechowywania, w pogłębiający się spoczynek zapadają nie tylko niełupki pochodzące z kwiatów jęczykowych, ale i z kwiatów rurkowych.