

PARS BOTANICA

STUDIES ON THE SELECTIVE GERMINATION INHIBITING EFFECT OF 2-METHYL-1,4-NAPHTOCHINON

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Introduction

It is known that a vitamin K preparate (2-methyl-1,4-naphtochinon sodium bisulphite) in low concentration, alone or together with auxins, stimulates the growth of the plants (1, 2). As the compound is of naphtochinon structure we assumed that in contrast to the stimulation a vigorous inhibition may also be produced with some other concentration. During examinations with aim other than the present one — where the intensive but extremely selective bactericidal effect of the vitamin K has been experienced — the question arose, whether any of the plants of the higher species, like some bacterial species, posses a strong resistance to these compounds. To approach the problem the effect of the vitamin K preparate has been studied on the germination of the seeds of 37 species of 16 families.

Material and method

In order to have uniform germination and to remove the inhibitory substances of the seed-coat the experimental seeds have been steeped in 100 ppm. solution, for 3 hours before incubation, in dark at room temperature. The control seeds have been treated in the same way in bidistilled water. Subsequently the seeds were germinated in Petri-dish in 100 ppm. vitamin K solution on filter paper soaked with bidistilled water respectively at 26 C° in dark. The incubation varied with the species and lasted as long as the control seeds reached the 100% germination. The seeds whose radicle just leaving the seed-coat were considered germinated. The standard error — according to species — ranged from ± 4 to $\pm 12\%$. The values on the Fig. are mean values.

Results and discussion

The vitamin K affects the germination of the seeds of the different species to a very variable extent. With the dicotyledons such as e. g. *Amaranthus*,

Dianthus, *Capsella*, *Lepidium*, *Sinapis*, *Plantago*, *Antirrhinum*, *Datura* and *Petunia* a 100% inhibition can be observed. Whereas no inhibition can be noted with the monocotyledons (Gramineae), as well as the *Cucumis* and *Pisum* of the dicotyledons. The seeds of the other species examined are within the limit

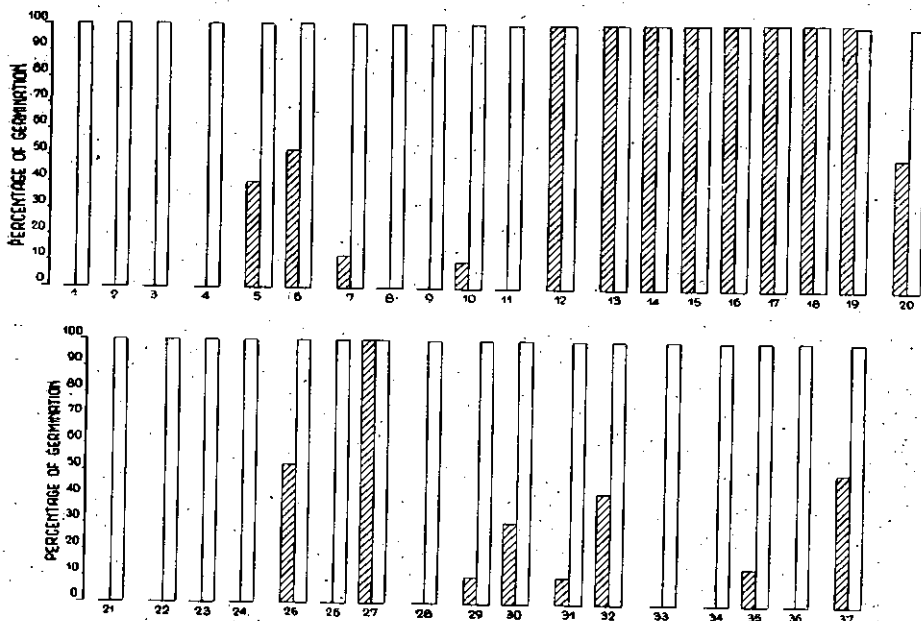


Fig. 1: The effect of vitamin K on the germination of the seeds of various plant species. Lined columns: germination percentage of treated seeds. Blank columns: control. Species examined¹:

Amaranthaceae:

1. *Amaranthus albus* L.
2. *A. paniculatus* L. var. *cruneatus*
»Pigmy«
3. *A. retroflexus* L.

Caryophyllaceae:

4. *Dianthus barbatus* L.

Compositae:

5. *Helianthus annuus* L. »Iregi«
6. *Lactuca sativa* L. »Nansen«

Cruciferae:

7. *Brassica oleracea* L. var. *sabauda* L.
8. *Capsella bursa-pastoris* L.
9. *Lepidium draba* L.
10. *Raphanus sativus* L.
11. *Sinapis alba* L.

Cucurbitaceae:

12. *Cucumis sativus* L.

Gramineae:

13. *Hordeum vulgare* L. »Hatvani 308«
14. *Avena sativa* L. »F«
15. *Oryza sativa* L. »Agostano«
16. *Panicum miliaceum* L.
17. *Secale cereale* L. »Kisvárdai P«
18. *Triticum aestivum* L. »Bánkuti 1201«
19. *Zea mays* L. »Szegedi lófógu«

Linaceae:

20. *Linum usitatissimum* L. »Szegedi olajfen«

Nyctaginaceae:

21. *Mirabilis jalapa* L.

Papaveraceae:

22. *Eschscholtzia californica* Cham.
23. *Papaver orientale* L.
24. *P. somniferum* L. »Fertődi kék«

¹ Columns of the Fig. 1 correspond to the number of the species.

Leguminosae:

25. *Lens culinaris* Medik.
 26. *Medicago sativa* L. »Kék lucerna«
 27. *Pisum sativum* L. »Caractacus«

Plantaginaceae:

28. *Plantago lanceolata* L.

Portulacaceae:

29. *Portulaca grandiflora* Hook.
 30. *P. oleracea* L.

Rubiaceae:

31. *Galium mollugo* L.
 32. *G. verum* L.

Scrophulariaceae:

33. *Antirrhinum majus* L. var. maximum »Alaska«

Solanaceae:

34. *Datura stramonium* L.
 35. *Solanum lycopersicum* L. »Lucullus«
 36. *Petunia hybrida* hort. nana compacta multiflora »Himmelsröschen«

Violaceae:

37. *Viola cornuta* L. »Firnenschnee«

values mentioned above, the inhibition, however, reaches or may surpass the 50%. Similar differences, if not so much pronounced, can be observed when comparing the behaviour of the families. Extremely marked is the full inhibition of the seeds of the *Amaranthaceae* and *Papaveraceae* families in contrast to the behaviour — fully corresponding with the control — of the seeds of the *Gramineae*. On the other hand the seeds of the species of the *Leguminosae* family behave diversely toward the vitamin K effect. E. g. the seeds of lucerne is inhibited 100%, at the same time the seeds of the peas germinated without any difficulty.

On the whole may be stated that the 2-methyl-1,4-naphtochinon affects selectively the germination of the seeds of the various species. This selectivity — apart from two exceptions — is especially remarkable when comparing the effect on the dicotyledons and monocotyledons (*Gramineae*). The cause of the selectivity is for the time being unknown. Anyhow, on the basis of the results obtained may be assumed that under proper circumstances the compound or its derivatives in adequate concentration may be used as a selective herbicide or elsewhere as a regulator. Moreover, as the compound possesses bactericidal and fungicidal property, it may be employed as a chemotherapeutic agent for grain crops.

Summary

The effect of 100 ppm. solution of the 2-methyl-1,4-naphtochinon (vitamin K preparate) has been examined with reference to the germination of the seeds of different plant species. The compound shows a considerable selectivity. 100% inhibition has been noted with the species of *Amaranthus*, *Dianthus*, *Capsella*, *Lepidium*, *Sinapis*, *Mirabilis*, *Eschscholtzia*, *Papaver*, *Medicago*, *Plantago*, *Antirrhinum*, *Datura* and *Petunia* — some of which are common weeds — at the same time, the germination of the *Gramineae* as well as those of *Cucumis* and *Pisum* of the dicotyledons was in no way affected by the compound.

References

- (1) *Hemberg, T.*: The effect of vitamin K and vitamin H on the root formation in cutting of *Phaseolus vulgaris* L. *Physiol. Plant.*, **6**, 17—20 (1953).
 (2) *Hemberg, T.* and *Lowen, B.*: The effect of vitamin K and naphtalene acetic acid on *Datura*. *Svensk Farm. Tidskr.*, **58**, 938—946 (1954).