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Endogenous auxins and growth inhibitors in the developing inflorescences and infructescences of black poplar (*Populus nigra* L.) *

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Abstract

The present work reports on some change in endogenous auxin content in black poplar inflorescences and infructescences in the course of their development.
The same groups of auxin were present in both inflorescences and infructescences examined. The maximum activity of auxin was found in male as well as female inflorescences about 3,5 cm long. The female ones, however, showed a higher level of total auxin content than the males.

INTRODUCTION

It is generally assumed that growth and development are regulated by a changing level of growth substances and their interactions. In the previous work the changes in the level of gibberellin-like substances which occurred in the course of development of black poplar inflorescences and infructescences were reported (Kamieńska 1967 a). The present paper deals with some changes in endogenous auxin content in the same plant material.

MATERIAL AND METHOD

The inflorescences and infructescences were collected from 80-year old black poplar trees grown at the Vistula valley, in Ostromecko. They were taken from the upper and medium parts of the tree crowns.
The development stages of the tested material were as follows:

I. Dormant buds,
II. Swollen buds,

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III. Inflorescences which emerged fully from their bud scales — about 2 cm. long,
IV. Inflorescences beginning to hang down from the branches — about 3,5 cm. long,
V. Inflorescences just before pollen dispersal — about 5 cm. long.

Infructescences were taken every 10 days counting from the third day of pollination (from May 12).

Auxins and growth inhibiting substances were extracted with 80% methanol using the method discribed by Phillips and Wareing (1958) and Robinson et al. (1963). The activity of growth substances was estimated with the *Avena* section straight growth bioassay. All other methodical particulars were the same as those described in the previous paper (Kamieńska 1971).

RESULTS

I. Black poplar inflorescences

Data on the auxin content in black poplar inflorescences are shown in Fig. 1 and 2. The results indicate that in the chromatograms there were three zones of auxin activity at R_Fs 0.1–0.2, 0.4–0.6, and 0.8–0.9. The inhibiting substances were found at R_F 0.7–0.8.

Only the auxin at R_F 0.1–0.2 was present in dormant flower buds. It could be indolepyruvic acid (IPyA) because of its position in the chromatogram, however closer examinations were not made. The dormant buds have shown the presence of this growth promoting substance in quantities of 0.0317 and 0.0292 μg IAA equivalent in 100 g of fresh sample of female and male plants respectively. The amount of this promoter was kept almost at the same level until the inflorescences were about 2 cm long and emerged fully from their bud scales. At the next stage, when the inflorescences began to hang down from the branches, a considerable increase in the amount of promoter at R_f 0.1–0.2 could be seen. It was observed for male and female inflorescences as well with the females still showing a much higher amount of the promoter than the male ones. Then the activity of the promoter at R_F 0.1–0.2 has decreased.

After the male and female inflorescences emerged from the bud scales and became 2 cm long, two other growth promoters have appeared. The promoter present at R_F 0.4–0.6 was probably the indoleacetic acid (IAA), however colour reaction with Salkowski's reagent had been not succeeded. Probably the amount of this auxin was too small to give a positive reaction, however standard IAA was located at the same R_F in the control chromatograms.

The level of the presumable IAA has shown a small but unsignificant increase in 5 cm long male and female inflorescences and then it has decreased.

The promoter present at R_F 0.8–0.9 has corresponded to the position of indole-

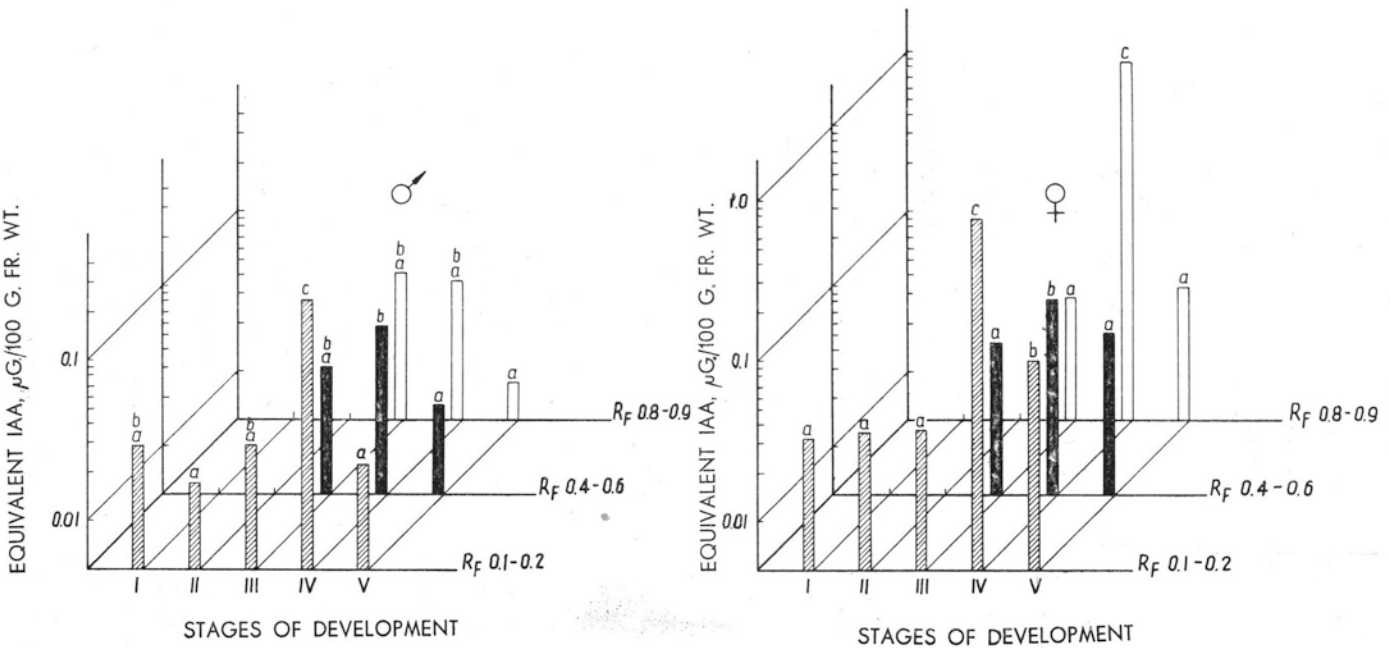

Fig. 1. Activity of auxin in the developing inflorescences of black poplar

Identical superscripts indicate differences not significant at P = 0.05 within all the stages and *RF* values.

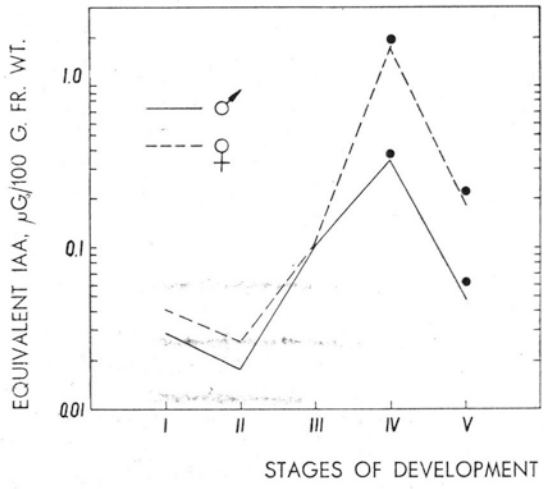

Fig. 2. Total auxin activity during the development of black poplar inflorescences.
Dots indicate differences significant at P = 0.01 within a given stage of development.

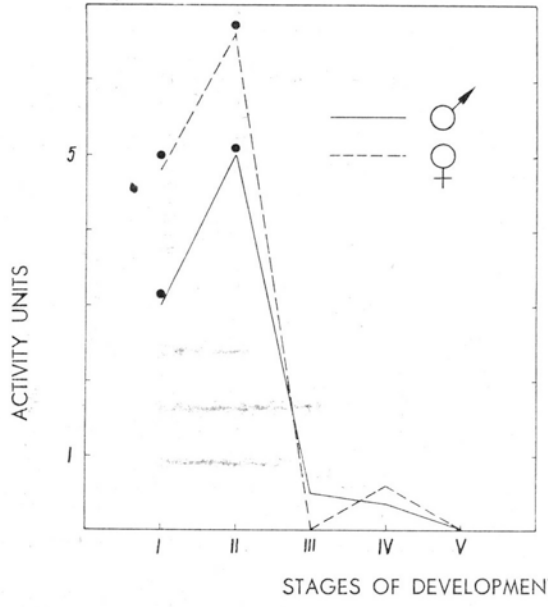

Fig. 3. Growth inhibiting substances in the developing inflorescences of black poplar.
Dots indicate differences significant at P = 0.01 within a given stage of development.

aceto nitril (IAN) in the control chromatograms. The promoter at R_F 0.8–0.9 has shown a decreasing level in the male inflorescences. In the female ones, when they began to hang down from their branches, a maximum activity of this promoter, reaching the amount of 0.843 μg equivalent IAA in 100 g of fresh weight was stated.

The female poplar inflorescences have also shown a much higher total amount of auxin than the male ones (Fig. 2).

The growth inhibiting substances were found in dormant buds showing the activity of 3.01 activity units in male, and 8.83 activity units in female buds. During the period of bud bursting the amount of inhibiting substances has increased up to its highest level both in male and female inflorescences. In the further stages of the development only traces of growth inhibiting substances were observed (Fig. 3).

II. Black poplar infructescences

In poplar fruit the same groups of growth regulators as in poplar inflorescences were found (Fig. 4).

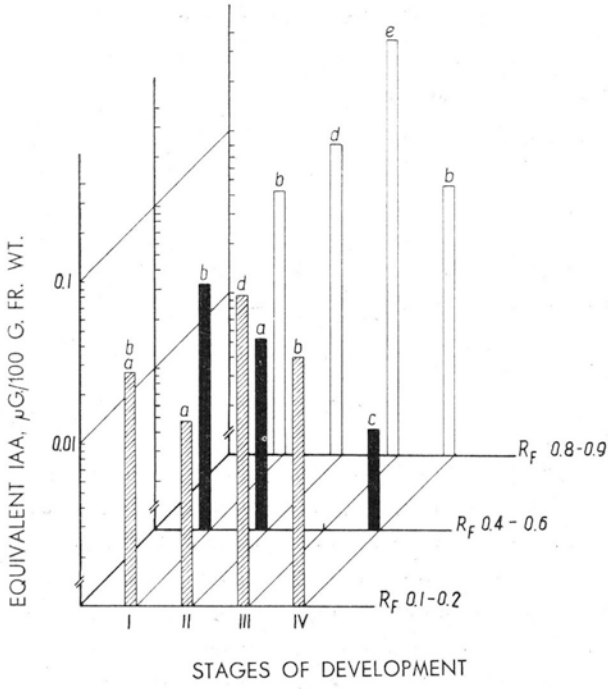

Fig. 4. Auxin activity during the ripening of black poplar infructescences.
Identical superscripts indicate differences not significant at P = 0.05 within all the stages and R_F values.

Three growth promoters were observed in the poplar capsules since the period of their formation till their ripening. The activities of growth stimulators at R_F 0.1–0.2 and 0.8–0.9 have increased slowly, reaching the maximum values on the 23rd day after pollination, and then they have decreased. The promoter at R_F 0.4–0.6, presumably IAA, have shown a decreasing activity with its highest value immediately after the pollination.

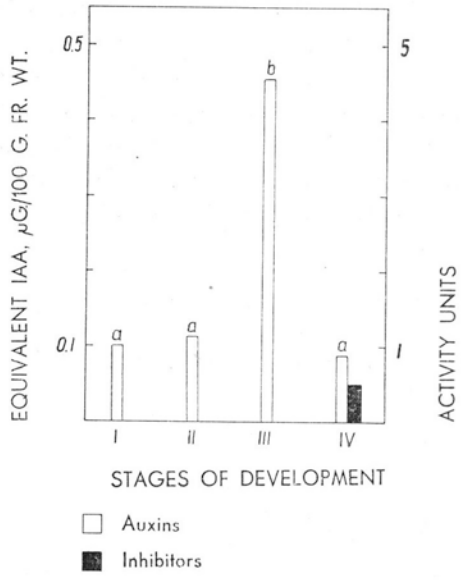

Fig. 5. Total auxin and inhibitor activities during the ripening of black poplar infructescences. Identical superscripts indicate differences not significant at P = 0.05.

The growth inhibiting substance in small quantity amounting to 0.51 activity unit was stated only in the capsules directly before their ripening (Fig. 5).

DISCUSSION

In many papers (Hemberg 1958; Ogasawara 1961; Pieniążek 1964; Lane and Bailey 1964) it was reported that dormant buds did not show auxin and gibberellin activities but they contained many growth inhibiting substances, however some amount of auxin was stated in dormant buds of beech, pine, spruce, and oak by Czaja (1934), and sycomore by Dörffling (1963). The present experiments showed the presence of growth inhibiting substances, as well as some auxin activity in dormant flower buds of black poplar. Buds taken to the analyses were probably not in the deep dormancy state, however, they were not swollen yet.

In swollen buds authors have usually stated the presence of an auxin similar to, or being IAA (Hashizume 1960; Ogasawara 1960). The auxin in the examined poplar buds could be considered to be IAA, it has appeared in the bursted buds while the inflorescences began to emerge from the bud scales. The other auxin-like substances at R_F 0.1–0.2 stated in the dormant buds could possibly be a substance similar to IPyA. It was rather impossible to obtain the activity of IPyA because of its small stability. It should be mentioned that the same groups of auxin were found in poplar inflorescences and fruits as those reported earlier for poplar leaves (Kamieńska 1971).

The levels of auxins were dependent on the stage of development of the inflorescences. The maximum auxin activity was found before pollination. A similar dependence was shown in the previous paper regarding gibberellin-like substances (Kamieńska 1967 a). Kopcewicz (1969) has reported the maximum auxin and gibberellin activity observed at the time of fertilization in female pine cones.

The results of the present work point toward the differences between auxin content in male and female plants (see also Kamieńska 1967 b). The female inflorescences showed higher auxin activity than the male ones, but the significant difference could be stated only in the stage IV. The earlier studies (Kamieńska 1967 a) already showed the larger amount of gibberellins in the female inflorescences than in the male ones, however the female poplar leaves contained smaller amount of gibberellins when compared with the male ones (Kamieńska 1966).

The same auxins which were active in developing inflorescences were also stated in developing poplar fruits. In the experiments on fruit one can notice the smaller activity of the presumable IAA and the higher activity of the presumable IAN than those observed for inflorescences. In the course of fruit ripening the total auxin activity had been changing, first it increased and then, before the fruits were ripe and dehisced, it decreased. Similar changes in the auxin activity were found in apple tree (Luckwill 1957), pear tree (Mimault 1956) and pine (Krugman 1965). The higher activity of gibberellin-like substances in immatured capsules of black poplar than in matured ones was reported in the previous paper (Kamieńska 1967 a). Many authors have shown (Phinney et al. 1957, Murakami 1961, Corcoran and Phinney 1962) that gibberellins increase to a maximum amount in the immature seeds and fruits, and then gradually disappear as the seeds become dry. Furthermore, qualitative and quantitative changes in the metabolism of growth substances during seed development are known (Luckwill 1954, 1957; Krugman 1965; Kentzer 1966).

CONCLUSIONS

1. Some quantitative and qualitative changes in the auxin content in inflorescences and infructescences which could be referred to their physiological state of development were found.

2. The dormant flower buds have contained certain amounts of auxin and a small amount of growth inhibiting substances.

3. The amount of auxins and growth inhibiting substances has increased in the course of inflorescences development and then it has decreased. The maximum amount of auxin was found in inflorescences beginning to hang down from the branches, the maximum amount of inhibitors — in bursting buds.

4. The auxins were present in comparative abundance in immature capsules about 10 days before they ripened and decreased in amount as the infrutescences matured; traces of growth inhibiting substances were found only in the mature capsules.

5. Female inflorescences, beginning to hang down from their branches, contained more auxin than the male ones.

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Endogenne auksyny i inhibitory wzrostu w rozwijających się kwiatostanach i owocostanach topoli czarnej (Populus nigra L.)

Streszczenie

Praca traktuje o zmianach w zawartości endogennych auksyn i inhibitorów wzrostu podczas rozwoju kwiatostanów i owocostanów topoli czarnej. Stwierdzono, że zarówno kwiatostany, jak i owocostany zawierają te same grupy auksyn. Tak męskie, jak żeńskie kwiatostany zawierały największą ilość auksyn po osiągnięciu 3,5 cm długości. Kwiatostany żeńskie zawierały jednocześnie w tym czasie więcej auksyn niż kwiatostany męskie. Największa aktywność inhibitorów związana była z fazą pękania pąków. W dojrzałych puszkach nasiennych wykryto jedynie śladowe ich zawartości.