ACTA AGROBOTANICA
Vol. 33, z. 1 — 1980
81-92

Effect of gibberellin, auxin and kinetin treatments combined with foliar applied NPK on the yield of *Capsicum annuum* L. fruits and their capsaicin content

TOMASZ JAN NOWAK

Botanical Garden, Wrocław University, Wrocław *

(Received: November 8, 1977)

Abstract

The Wrocław version of hydroponic culture was applied. Under optimal conditions of root fertilization the plants were sprayed with growth regulators such as gibberellins, auxins and kinetins, and their mixtures. Each growth regulator treatment was applied with or without NPK added. The influence of these treatments on the fresh and dry weight of the fruit, percentage of ripe fruits and content and yield of capsaicin was studied. The highest yield of fruits and capsaicin was obtained from plants sprayed with gibberellic acid and kinetin (in concentrations of 10 and 5 mg/l, respectively) together with NPK foliar application. No influence of growth regulators and foliar-applied NPK was noted on capsaicin content and dry weight of fruits.

INTRODUCTION

Growth regulators are more and more frequently tested as a means of increasing the yield of crop plants (Weaver, 1972). However, relatively not many studies have been performed on the influence of these compounds on *Capsicum annuum* L. Treatment of *Capsicum* with gibberellic acid (GA_3) speeds up apical growth, inhibiting at the same time flowering at the first node (Rylski, 1972) and it reduces the number of friuits (Kim, 1975). In investigations on hot *Capsicum* varieties no influence of GA_3 on the capsaicin content in the fruits was observed. It has been demonstrated, on the other hand, that a single spraying causes faster growth of the plant, this action decreasing

* Present address: Agro and Hydrometeorological Department, Agriculture Academy of Wrocław, Plac Grunwaldzki 24, 50-363 Wrocław.

with lapse of time after the spraying (Czabajska and Okoniewska 1968).

The influence of auxins on the yield of *Capsicum* is not consistent. By applying auxins to the roots in hydroponic culture an increase of yield may be obtained (Tafuri et al., 1973). Naphthylacetic acid (NAA) reduces the number of fruits (Kim, 1975), owing to degeneration of flower buds on the first node and retardation of flowering at the second and third one (Rylski, 1972). The yield of *Capsicum* can be raised, however, by foliar application of NAA in a 50 mg/l concentration by about 40 per cent (Mote et al., 1975). The influence of auxin on the flowering and yield of *Capsicum* may depend among other things on the climatic conditions. Treatment of the plants with 2,4D (2,4-dichlorophenoxyacetic acid) in the summer period inhibits flowering and reduces the yield, whereas in the winter period it enhances the former (Wally et al., 1971).

The requirements of *Capsicum annuum* for nutrient components vary according to the development phase (Horwáth and Bujk, 1934; Špaldon, 1948; Špaldon and Ivanič, 1968). As reported by these authors, *Capsicum* intensively utilises nitrogen and potassium in the period from planting to the beginning of flowering. Phosphorus uptake in this period is low and increases from the period of flowering to fruit formation. In the last part of vegetation period phosphorus and potassium uptake increase, whereas that of nitrogen distinctly diminishes. In the course of the whole vegetation period *Capsicum* exhibits the highest requirements for nitrogen and potassium and less for phosphorus (Jaruszewski and Owsiany, 1958; Golcz et al., 1970).

The purpose of the present study was to test the joint action of growth regulators and foliar NPK fertilization on the yield of *Capsicum* fruits and on their capsaicin content. Experiments on the cultivation of this plant and foliar fertilization are described in other forthcoming papers (Nowak, 1980a, b, c).

METHODS

The experiments lasted from 21 May to 6 October, 1975. They were performed in the glasshouse of the Botanical Garden of the Wrocław University, with application of hydroponic culture according to the Wrocław version (Gumińska and Gumiński, 1976), in which the plants are growing in a thin layer of the substrate contained in the upper part (with perforated bottom) of the "two part" hydroponic vessel. In the lower part of this vessel there was a thin layer of hydroponic solution. There was always a few cm distance between the substrate and solution to provide good aeration of roots.

Capsicum seeds of the 'Bronowicka ostra' (hot) variety were sown directly into the hydroponic substrate. The nutrient solution and substrate are described in another paper (Nowak, 1980b).

Growth regulators were applied in a spray to the leaves. Gibberelic acid (GA_3) in 0.1, 1 and 10 mg/l concentration; indolylacetic acid (IAA) — 5. 50 and 500 mg/l and kinetin 0.5, 5 and 50 mg/l. The same substances were also applied in mixture (Table). Growth regulators were applied together with NPK sprays as indicated in Table 1.

Table 1

Foliar application of NPK

Period of application	Composition of nutrient solution (g/l tap water)	No. of sprayings
From penetration of roots to medium to the beginning of flowering	urea 3+salpetre 2	7
From flowering to formation of first fruits	urea 2+salpetre 2+ superphosphate 1	2
In the remaining part of the vegetation period	salpetre 2+supper-phosphate 3	6

Foliar application of NPK was done according to the following scheme.

Sprayings were done in the morning hours at an air temperature of 20-25°C every week after the root system had penetrated into the medium. The dosage was based on the nutritional requirements of *Capsicum* in the particular developmental phases and over the entire vegetation period (see Nowak, 1980b).

The experiment was run in two series: with and without foliar NPK application. Control plants were sprayed with distilled water, and in the series with foliar application of nutrient solution only with this solution without growth regulators. In the period between emergence and beginning of flowering each time 1 plant was sprayed with 30 ml of the tested solution, and in the later period with 40 ml.

The chosen meteorological influences in the course of the experiment are shown in the Figure 1.

The fresh weight of fruits, their dry weight, the per cent of ripe fruits, their content of capsaicin and its yield as well as the number of flowers set, of fruits not shed and the fresh weight of one fruit were determined. Capsaicin contentin fully coloured fruits was deter-

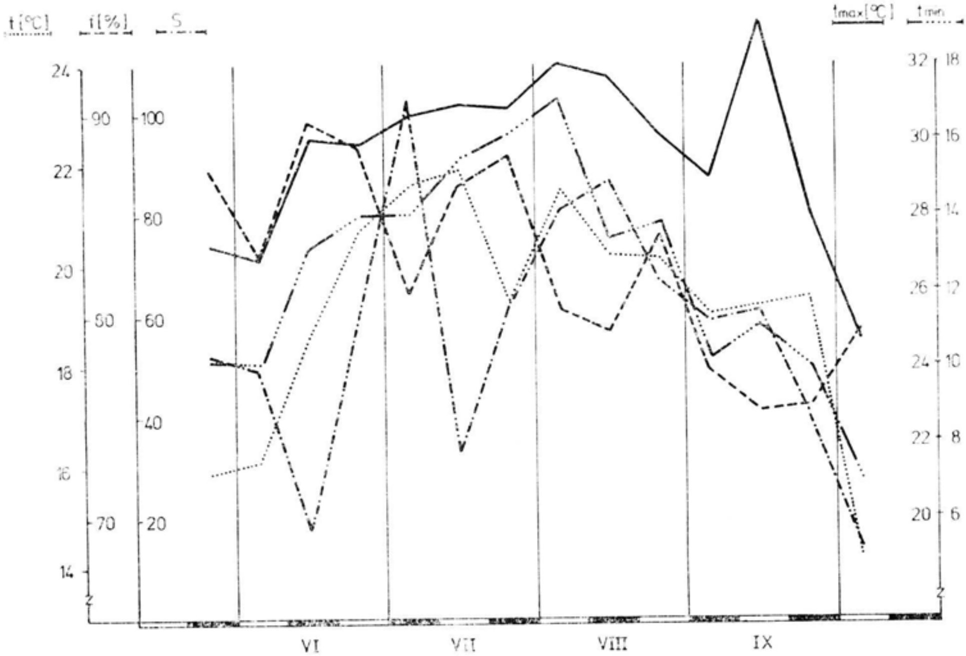

Fig. 1. Course of 10-day air temperature values (t), relative air moisture (f), insolation (S) in hours, maximal (t_{max}) and minimal (t_{max}) air temperatures in glasshouse (values S from Agro-hydrometeorological Station, Wrocław-Swojec)

mined colorimetrically with the use of ammonium vanadate (J o ń c z y k, 1967).

Each combination included 6 replications. One replication consisted of one plant growing in one jar. The results were statistically elaborated by analysis of variance (O k t a b a, 1976) the significance of differences between all pairs of means was estimated by Duncan's multiple range test (D u n c a n, 1955).

RESULTS

Foliar application of fertilizers as well as treatment with growth regulators strongly affected the fresh weight yield of *Capsicum* fruits (Table 2). GA_3 treatment increased the friuit yield. The strongest effect was obtained with the highest concentration applied (10 mg/l). IAA in 50 and 500 mg/l concentrations depressed strongly the yield, whereas in 5 mg/l solution it had no effect. Treatment with kinetin in 5 mg/l concentration increased the yield of fruit. This compound in 50 mg/l concentration inhibited fruit production in plants not receiving foliar fertilization, and in 0.5 mg/l it had no effect.

Table 2

The influence of GA_3, IAA, kinetin and foliar fertilization on the fresh matter of *Capsicum annuum* L. fruits

Growth regulators and concentration (ppm)		Fresh matter of fruits in grams per one plant (means of 6 replications) — foliar fertilization −	+
Control	0	43.1 i (d'-f')	58.5 fg (ł-o)
GA_3	0.1	50.1 h (uwz)	69.5 d (ghi)
	1	54.8 g (prs)	74.7 c (ef)
	10	79.5 b (cd)	90.6 a (b)
IAA	5	44.4 i (c'd'e')	59.3 f (l-n)
	50	38.8 jk (g'h'i')	50.5 h (t-z)
	500	34.0 l (k')	42.0 ij (d'e'f')
K	0.5	45.0 i (b'-e')	65.0 e (jk)
	5	58.0 fg (m-p)	79.7 b (cd)
	50	37.0 kl (i'j'k')	66.8 de (hij)

The results presented in Tables 2-5 derive from the same experiment, so each value in one table can be compared with values in other tables. The letters in parenthesis serve for such comparison, whereas the letters before the parenthesis serve only for comparison with other values in a given table.

Denotations in Tables 2-5: GA_3-gibbereli acid, IAA-indoliloacetic acid, K-kinetin.

When GA_3 and kinetin were jointly applied, the influence of both these compounds was summated. A medium kinetin concentration stimulated the fruit yield more than did lower concentrations and as a rule much stronger than higher ones. An exception was the behaviour of plants treated with 10 mg/l GA_3, at which concentration medium and lower kinetin concentrations had a similar effect. Gibberellin application attenuated the inhibition of fruit production due to the use of a supraoptimal kinetin concentration (50 mg/l).

The effects of GA_3 and IAA were also additive when they were applied jointly. Growth inhibition by higher IAA concentrations was the stronger, the more intensive were growth stimulation by GA_3 and foliar fertilization, for instance in plants not receiving foliar fertilization and at lowest GA_3 concentration, inhibition of fruit production by a 500 mg/l IAA concentration was 9 per cent (in relation to yield at 5 mg/l), whereas in plants with fertilizer foliar-applied and treated with 10 mg/l GA_3 inhibition reached 35 per cent.

Joint use of IAA and kinetin gave a typically additive effect. The higher was IAA concentration the lower was the yield, and on the

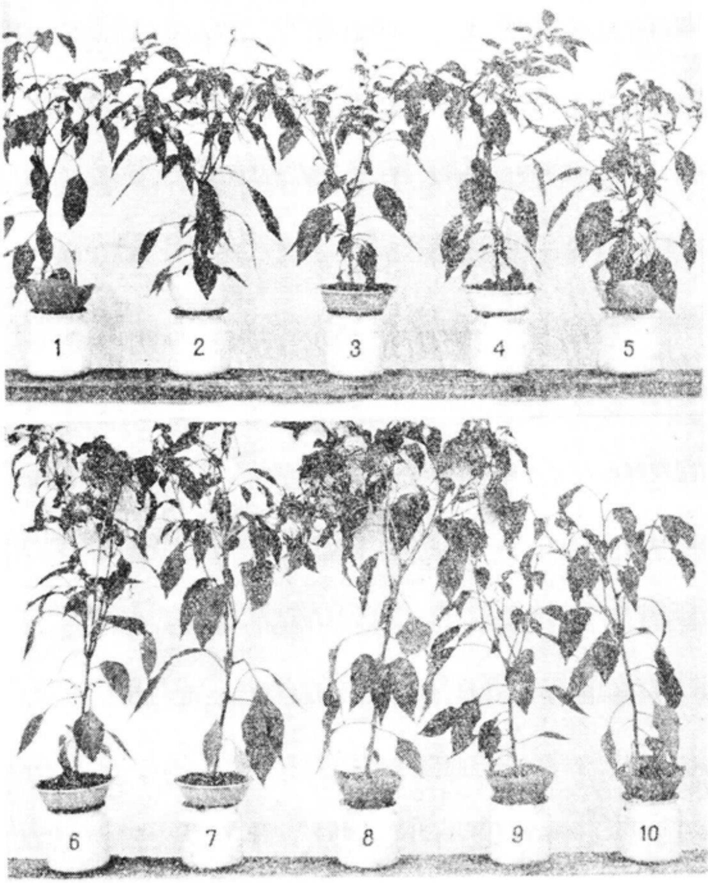

Fig. 2. The effect of growth regulators on growth of *Capsicum annuum* L.

Upper row: 1) control, non sprayed plant; 2) control, sprayed with water; 3) treated with GA 0.1 mg/l; 4) GA 1 mg/l+IAA 5 mg/l; 5) GA 1 mg/l+IAA 50 mg/l. Lower row: 6) GA 10 mg/l+kinetin 0.5 mg/l; 7) GA 10 mg/l+kinetin 5 mg/l; 8) GA_3 10 mg/l+kinetin 50 mg/l; 9) IAA 5 mg/l; 10) IAA 5 mg/l+kinetin 0.5 mg/l.

other hand, a medium kinetin concentration always caused a better yield than did lower or higher doses. The yield with the highest kinetin dose was generally worse than with the lowest one.

Foliar application of NPK increased the friuit yield in all combinations with or without growth regulators (Tables 2-5). GA_3 addition in most cases did not influence or diminished this influence. The positive influence of fertilization in most cases decreased in the presence of IAA. Foliar application of fertilizer in most cases stimulated the action of kinetin of 0.5 and 5 mg/l concentration and neutralized the negative influence of the supraoptimal concentration of the latter. The

Table 3

The influence of GA_3 with kinetin and foliar fertilization on the fresh matter of *Capsicum annuum* L. fruits

Mixture of growth regulators		Fresh matter of fruits in grams per one plant (means of 6 replications)	
		foliar fertilization	
GA_3	K	−	+
Control		43.1 g (d'-f')	58.5 d (ł-o)
0.1	0.5	53.0 e (r-u)	72.3 c (fg)
	5	58.3 d (ł-o)	77.8 b (de)
	50	46.0 f (a'-d')	68.7 c (ghi)
1	0.5	54.7 de (prs)	71.0 c (g)
	5	62.2 d (kl)	82.7 b (c)
	50	47.5 f (za'-c')	62.3 d (kl)
10	0.5	71.8 c (fg)	92.8 a (ab)
	5	78.3 b (d)	94.2 a (a)
	50	52.2 e (stu)	72.2 c (fg)

Table 4

The influence of GA_3 with IAA and foliar fertilization on the fresh matter of *Capsicum annuum* L. fruits

Mixture of growth regulators		Fresh matter of fruits in grams per one plant (means of 6 replications)	
		foliar fertilization	
GA_3	IAA	−	+
Control		43.1 hi (d'-f')	58.5 d (ł-o)
0.1	5	45.0 h (b'-e')	57.0 de (n-q)
	50	43.5 hi (d'e'f')	55.3 ef (o-s)
	500	40.9 i (f'g'h')	50.8 g (t-z)
1	5	56.5 e (n-q)	69.8 c (gh)
	50	52.5 fg (r-u)	59.8 d (l-n)
	500	45.8 h (b'-e')	53.7 efg (q-u)
10	5	79.0 b (d)	92.8 a (ab)
	50	60.7 d (lłm)	80.0 b (cd)
	500	54.4 efg (prs)	59.7 d (l-n)

fruit yield of the foliar fertilized plants treated with 10 mg/l gibberellin with 0.5 or 5 mg/l kinetin added was 90.6, 92.8 and 94.2 g, respectively, per plant and was twice that of control unfertilized plants (43.1 g per plant).

Table 5

The influence of IAA with kinetin and foliar fertilization on the fresh matter of *Capsicum annuum* L. fruits

Mixture of growth regulators		Fresh matter of fruits in grams per one plant (means of 6 replications)	
IAA	K	foliar fertilization −	+
Control		43.1 k (d˙-f˙)	58.5 cd (ł-o)
5	0.5	44.8 jk (b˙-e˙)	66.2 b (ij)
	5	58.3 cd (ł-o)	76.7 a (de)
	50	42.8 k (d˙e˙f˙)	52.8 fg (r-u)
50	0.5	48.0 ij (za˙b˙)	56.9 de (n-q)
	5	52.0 gh (tuw)	68.8 b (g-j)
	50	36.6 l (i˙j˙k˙)	56.0 de (opr)
500	0.5	38.2 l (h˙i˙j˙)	53.8 efg (q-t)
	5	43.7 k (d˙e˙f˙)	61.6 c (klł)
	50	24.8 l (j˙k˙)	48.6 hi (wza˙)

Table 6

Influence of GA_3, IAA, kinetin and foliar fertilization on the number of flowers set, number of fruits not shed and on the fresh weight of one fruit fo *Capsicum annuum* L. (averages of 6 repetitions)

Growth regulator and concentration (mg/l)		Number of flowers set −	+	Number of fruits not shed −	+	Fresh weight of one fruit (g) −	+
Control	0	67 de	72 cd	5.3 fgh	6.5 de	8.12 e-h	9.00 c-f
GA_3	0.1	63 def	68 cde	6.7 cd	8.2 b	7.55 gh	8.78 d-g
	1	79 bc	84 bc	7.7 bc	8.3 b	7.17 h	9.02 c-f
	10	91 a	89 ba	9.8 a	9.9 a	8.20 e-h	9.15 cde
IAA	5	70 cd	65 def	5.5 e-h	6.7 cd	8.20 e-h	8.85 d-g
	50	62 def	60 def	4.8 ghi	5.5 e-h	8.10 e-h	9.18 cde
	500	54 f	57 ef	4.0 i	4.7 hi	8.32 e-h	9.08 c-f
K	0.5	69 cd	67 de	5.8 d-g	6.3 def	7.83 fgh	10.33 bc
	5	71 cd	65 def	5.9 d-g	6.8 cd	9.80 bcd	11.82 a
	50	64 def	70 cd	5.3 fgh	6.3 def	7.00 h	10.62 ab

Values not marked with the same letter differ significantly according to Duncan's multiple range test ($p=0.05$).

Denotations: −without foliar fertilization, +with foliar fertilization.

The methods of treatment affected also the number of flowers produced by the plants, the number of fruits not shed and the fresh weight of one fruit (Table 6). GA_3 with exception of the lowest concentration increased the number of flowers and the number of fruits not shed. Treatment with IAA in the highest concentration inhibited flowering and reduced the number of fruits not shed. Kinetin in the concentration 5 mg/l (or also in 50 mg/l with foliar fertilized plants) increased the weight of one fruit.

NPK foliar application usually increased fruit retention and the weight of one fruit, but did not affect flowering.

When growth regulators were applied jointly in pairs their influence in most cases was less pronounced than in single treatment.

Growth regulators and foliar fertilization were not found to influence the dry weight of the fruits. It varied from 16.5 to 17.8 per cent. The capsaicin content in the fruits varied from 1.76 to 1.91 mg/g dry weight and did not depend on growth regulators treatment and on foliar fertilization. The capsaicin yield from one plant was 10.7 to 30.2 mg and was the higher the greater was the fruit yield from the plant. The per cent of ripe friuits varied from 90.5 to 100. There was tendency to retarded ripening under the influence of foliar fertilization.

DISCUSSION

The growth regulators tested and foliar NPK application did not change the capsaicin content in the fruits. Similar results with GA_3 were obtained by Czabajska and Okoniewska (1968). The absence of interaction between NPK fertilization and capsaicin content confirms the data of Golcz et al. (1970) and Jaruszewski and Owsiany (1958). If we consider the capsaicin yield from one plant, it would seem purposeful to apply 10 mg/l GA_3 in the form of sprayings together with foliar NPK application (taking into account the nutritional requirements in particular developmental phases). To these sprayings with GA_3 and NPK, kinetin may be added in 0.5 or 5 mg/l concentration. Growth regulators and NPK indirectly enhance the capsaicin content by increasing the fruit yield.

The increased fruit yield of *Capsicum annuum* due to treatment with GA_3 confirms the data reported in numerous papers concerning the stimulating effect of gibberellin on yielding of various plants (Muromtsev and Agnistikova, 1973; Maciejewska-Potapczykowa, 1967; Weaver, 1972). Auxins stimulate flowering and fructification in some plants, whereas in others they have an inhibitory effect (Fischer and Loomis, 1954; Grochowska, 1960; Hillman, 1970). As indicated by the present results, IAA decreases fruit yield in *Capsicum* (Table 2) by reducing the number of flowers set and fruits retained (Table 6). The stimulating influence of kinetin on the fruit yield may be associated with its effect on protein biosynthesis. Such an influence of kinetin seems to be indicated by the results of Osborn (1959, 1962). Kinetin increased also the fresh weight of one fruit. The influence of kinetin alone in combination with foliar NPK application seems interesting (Table 1). Insofar as the influence of kinetin alone on fruit yield of plants not receiving foliar fertilization is strongly dependent on its concentration (0.5 mg/l has no effect, 5 mg/l increases and 50 mg/l decreases the fruit yield), the joint treatment with kinetin and foliar fertilization increases the yield at all concentrations. This interaction of kinetin with foliar NPK application may be due to the influence of kinetin on protein biosynthesis. An enhanced biosynthesis under the action of kinetin is connected, among other things, with an increased requirement for amino acids, indirectly for nitrogen. It would seem that nitrate nitrogen supplied through the leaves can be built into the amino acids quicker in the presence of kinetin. This possibility is supported by the results of Steer (1976) who demonstrated an enhanced nitrate reductase activity in *Capsicum* treated with kinetin.

The great height of plants receiving GA_3 (Fig. 2) supports the results reported by other authors, concerning the stimulating effect of gibberellin on the growth of *Capsicum* (Czabajska and Okoniewska, 1968; Rylski, 1972). The more abundant flowering and better fruit retention under the influence of GA_3 (Table 6) is in contradiction with the results of Rylski (1972) and Kim (1975). It is possible that the effect of GA_3 on flowering and fructification is, similarly as that of NAA dependent on climatic conditions (Wally et al., 1971).

In the joint influence of GA_3 and IAA, GA_3 and kinetin as well as of IAA and kinetin on the quality and quantity of *Capsicum* fruits synergism was not noted. The problem of interaction of growth regulators is so far but little known and requires further investigations with simultaneous study of the level of endogenous regulators under definite climatic conditions.

The author wishes to thank Doc. dr habil. Z. Gumińska of the Botanical Garden of the Wrocław University for valuable advice and guidance in the course of the experiments and Doc. dr habil. J. Kozłowski of the Institute of Medicinal Herbs Industry, Poznań for suggesting some problems connected with medicinal plants.

REFERENCES

Czabajska W., Okoniewska J., 1968. Czy stosowanie kwasu giberelinowego może mieć praktyczne zastosowanie w produkcji pieprzowca. Ziel. Biul. inf., 12: 7-9.

Duncan D. B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.

Fischer J. E., Loomis W. E., 1954. Auxin-florigen balance of soybean. Science, 119: 71-73.

Golcz L., Kordana S., Załęcki R., 1970. Potrzeby pokarmowe pieprzowca rocznego (*Capsicum annuum* L.). Herba pol., 2: 107-124.

Grochowska M. J., 1960. Walka z przemiennym owocowaniem jabłoni przez stosowanie syntetycznych regulatorów wzrostu w okresie różnicowania pąków kwiatowych. Post. Nauk rol., 4: 45-50.

Gumińska Z., Gumiński S., 1976. Próchnicowa uprawa hydroponiczna roślin. Prace WTN, seria B, nr 192, wyd. Zakład Narodowy im. Ossolińskich — Wrocław.

Hillman W. S., 1970. Fizjologia kwitnienia (The physiology of flovering. Holt, Rinehart and Winston, Inc., 1962, tłum. pod red. A. Listowskiego). PWRiL, Warszawa.

Horváth F., Bujk G., 1934. A paprikanövény tápanyagfelvétele és tápanyagfelvétele és tápanyagkihasználása. Kiśerl. Közl., 36: 46-55.

Jaruszewski W., Owsiany J., 1958. Nawożenie mineralne pieprzowca rocznego. Biul. Inst. Rośl. Lecz., 4: 247-252.

Jończyk J., 1967. Porównanie metod oznaczania kapsaicyny w *Fructus capsici*. Herba pol., 13: 120-134.

Kim C. S., 1975. The effects of fertilizers, growth regulators and air temperature on fruit set in red peppers. J. Korean Soc. Hortic. Science, 16: 167-184.

Maciejewska-Potapczykowa W., 1967. Substancje wzrostowe roślin. PWRiL, Warszawa.

Muromtsev G. S., Agnistikova V. N., 1973. Gormony rastenij — giberelliny. Izd. Nauka, Moskwa.

Mote U. N., Patil A. V., Warhal K. N., 1975. Effect of NAA (planofix) sprays on flower drop and yield in important varieties of chillies (*Capsicum annuum* Linn.). Res. J. Mahatma Phule Agric. Univ., 6: 57-60.

Nowak T. J., 1980a. Wpływ różnych metod uprawy i terminów siewu na plon owoców pieprzowca rocznego (*Capsicum annuum* L.) Biul. warz., 00: 000-000.

Nowak T. J., 1980b. Effect of foliar fertilization of *Capsicum annuum* L. together with optimal root fertilization in hydroponic culture on fruit yield and its capsaicin content. Acta agrobot., 33: 000-000.

Nowak T. J., 1980c. Influence of increased doses of microelements in hydroponic nutrient solution on the yield of *Capsicum annuum* L. fruits and their capsaicin content. Acta agrobot., 33: 000-000.

Oktaba W., 1976. Elementy statystyki matematycznej i metodyka doświadczalnictwa. PWN, Warszawa, wyd. IV.

Osborne D. J., 1959. Control of leaf senescence by auxins. Nature, 183: 1459-60.

Osborne D. J., 1962. Effect of kinetin on protein nucleic acid metabolism in *Xanthium* leaves during senescence. Plant Physiol., 37: 595-602.

Rylski I., 1972. Regulation of flowering in sweet pepper (*Capsicum annuum* L.) by external application of several plant growth regulators. Israel J. Agric. Res., 22: 31-40.

Špaldon E., 1948. Koreninová paprika, jej botanické vlastnosti a pestovanie, chemické zloženie a technologické spracovanie. PPPR, Bratislava.

Špaldon E., Ivanič J., 1968. Študium prijímania živín koreninovou paprikou so zretel'om na dynamiku zmien v úrovni výživy a vzájomnych pomerov medzi živinami cez vegetáciu. Polnohosp., Agric., 4: 296-303.

Steer B. T., 1976. Rhythmic nitrate reductase activity in leaves of *Capsicum annuum* L., and the influence of kinetin. Plant Physiol., 6: 928-32.

Tafuri F., Businelli M., Giusquiani P. L., 1973. Influenza degli acidi di aluene specie articole in idroponica. Procc. of the Third Intern. Cong. on Soil. Cult., Sassari, s. 113.

Wally Y. A., Ghandour M. A. El., Fadl M. S., 1971. Effect of 2,4 D and IBA on flowering, fruit setting, shedding yield and endogenons regulating substances in sweet pepper. Hortic. Abst., 43 (8756).

Weaver R. J., 1972. Plant growth substances in agriculture. W. H. Freeman and Comp., San Francisco.

Wpływ gibereliny, auksyny i kinetyny oraz dolistnego dokarmiania NPK na plon owoców *Capsicum annuum L.* i na zawartość w nich kapsaicyny

Streszczenie

Badano rośliny pieprzowca rocznego odmiany 'Bronowicka ostra' w uprawie hydroponicznej w wersji wrocławskiej, stosując optymalne nawożenie dokorzeniowe. Cotygodniowo (łącznie 15 razy) stosowano prócz tego dokarmianie dolistne NPK, oraz traktowanie regulatorami wzrostu. Giberelina w stężeniu 0,1-10 mg/l zwiększała plonowanie stymulując kwitnienie i utrzymywanie owoców, tym silniej im silniejsze było jej stężenie. Kwas indolilooctowy w stężeniu 5 mg/l był na ogół bez wpływu, a w dawkach 50 i 500 mg/l obniżał plony, hamując kwitnienie i utrzymywanie owoców, tym silniej im wyższe było stężenie. Kinetyna w stężeniu 5 mg/l nie miała wpływu, w stężeniu 5 mg/l stymulowała, a w stężeniu 50 mg/l obniżała plonowanie. W połączeniu z dolistnym dokarmianiem wszystkie stężenia kinetyny stymulowały plonowanie, ale najsilniej 5 mg/l. Kinetyna nie wpłynęła na liczbę wytworzonych kwiatów i utrzymanych owoców. Nie stwierdzono synergizmu między regulatorami wzrostu, gdy stosowano je łącznie, parami. Wpływ ich był addytywny. Rośliny dokarmiane dolistnie zawsze silniej plonowały, niż rośliny podobnie traktowane, ale nie dokarmiane. Zawartość suchej masy w owocach i zawartość w nich kapsaicyny nie zależała od traktowania regulatorami wzrostu i dolistnego nawożenia NPK.