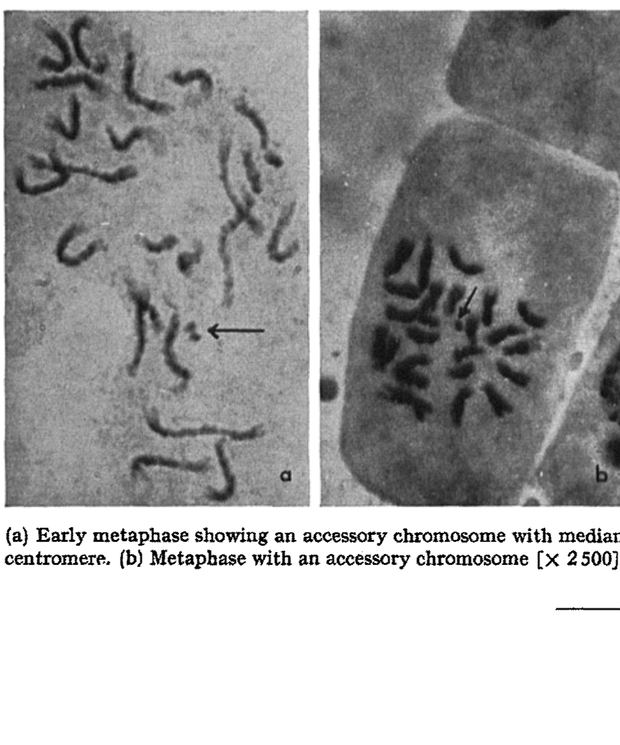
Accessory Chromosomes in *Physalis ixocarpa*

In connection with the cytotaxonomic studies of some species of the genus *Physalis* (Solanaceae), *P. ixocarpa* Brot. was found to have an accessory chromosome in addition to the normal complement of $2n = 24$. This chromosome, which has a median centromere and is distinctly smaller than the other chromosomes of this plant (Figure), was observed during mitosis as well as in meiosis. The meiotic studies showed that in a few pollen mother cells the accessory chromosome paired with one of the bivalents to form a trivalent, whereas in majority of cells it remained unpaired and divided already at diakinesis. Although in a few cases it lagged at anaphase I, it could be traced through the second division only rarely. There are no apparent differences in pollen size of the normal plants and those with an accessory chromosome. This is contrary to the observations in *Zea mays* where distinct differences in pollen size have been noted[1]. Out of the 7 species examined only *P. ixocarpa* exhibited the presence of an accessory chromosome.

No seeds were produced when the plant with an accessory chromosome was self-pollinated even though meiosis was regular with 12 bivalents at metaphase I. On the other hand, the plants without it were found to be self-fertile. Occasionally, the presence of quadrivalents and anaphase bridges were noticed, but the percentage of such abnormalities was rather low. Presumably this sterility was caused by the accessory chromosome or by genes situated on it, though other possibilities cannot be excluded at present.



(a) Early metaphase showing an accessory chromosome with median centromere. (b) Metaphase with an accessory chromosome [× 2500].

In spite of considerable cytogenetical work on several north American species of *Physalis*, including *P. ixocarpa*[2], the presence of accessory chromosomes have not been reported in any of the species. This is the first record of accessory chromosome in the genus *Physalis*, although they have been encountered in various other genera of Solanaceae[3-5], as well as many other families. Recent researches and improved techniques in cytology have been useful in understanding the morphology and behavior of the accessory chromosomes better, both in somatic and mitotic preparations[6]. Although their origin and significance has been studied more closely mostly in grasses[7], much still remains to be known about their behavior in other plants[8].

Zusammenfassung. Das Vorkommen eines Neben-Chromosoms ist zum ersten Mal in der Gattung *Physalis* festgestellt worden. Das kleine Chromosom besitzt ein in der Mitte liegendes Centromer und tritt sowohl bei der Mitose, wie auch bei der Meiose in Erscheinung. Pflanzen mit diesem Chromosom sind steril.

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Physiological Significance of Soil Moisture beyond the Permanent Wilting Percentage

The amount of water available to a plant is determined by the moisture characteristics of the soil, such as field capacity and permanent wilting percentage, often used in connection with upper and lower limits of available soil moisture for plant growth. KIESSELBACH[1] and MAXIMOV[2] observed that drought resistant plants have the peculiarity to utilize the water below the limit of permanent wilting point more economically by entering into a state of permanent wilting. TAYLOR, BLANEY and McLAUGHLIN[3] reported that many species of plants survived for considerable periods in soil drier than the permanent wilting percentage. FURR and REEVE[4] observed that the moisture in the wilting range, while it is unavailable for growth, is available for survival and the proportion of the total available moisture within this range is great enough to be of considerable significance in plant water relations. BRIGGS and SHANTZ[5], and

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Varieties	Soil moisture %			Height of plant in cm		
	At sunflower wilting	At plant wilting	At plant death	At sunflower wilting	At plant wilting	At plant death
Co. 312	6.40	3.25	2.55	12.10 (78.90)[a]	12.65 (63.25)	12.65 (37.55)
Co. 859	6.35	4.45	2.80	11.50 (75.95)	11.64 (68.65)	11.64 (43.12)
Co. 453	6.50	3.62	2.60	13.50 (76.40)	13.75 (66.20)	13.75 (40.32)
Co.S. 510	6.37	3.12	2.60	12.40 (77.20)	12.75 (65.15)	12.75 (38.45)
Co.S. 416	6.15	3.60	2.65	12.50 (76.12)	12.65 (67.38)	12.65 (41.15)

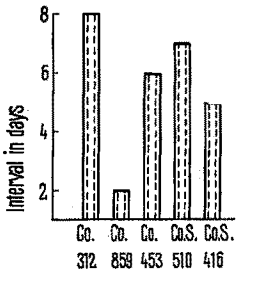
[a] Figures in brackets indicate shoot tissue moisture %.

SLATYER[6] reported that beyond the permanent wilting point further extraction of water often continues but with such a slow rate that it can not support plant growth.

The capacity of 5 sugarcane varieties, viz. Co.S. 510, Co. 312, Co. 859, Co.S. 416 and Co. 453 to survive drought periods with soil moisture below permanent wilting point, as measured by growing sunflowers along with sugarcane plants in a standardized quantity of soil, was tested with the method reported in detail in the earlier paper of the author[7]. Attention was paid to note the correct time when the permanent wilting of sunflower and also wilting of plant and its death occurred. Soil moisture was determined at different stages. The shoot tissue moisture of the plants and their growth were also taken at all stages. These data are shown in the Table.

It was observed that sugarcane plants reduced the moisture of a soil to 3.60 and 2.64% at their wilting and death respectively, but that sunflower wilted in the same soil to a moisture content of about 6.5%. FOWELLS and KIRK[8] working with *Pinus ponderosa* seedlings found similar results. This indicated the ability of sugarcane plant to extract soil moisture until they have died of dessication, but at such a slow rate that restoration of turgidity was impossible, which may probably be due to the higher rate of transpiration than the rate of absorption of water from a soil at and below its permanent wilting point. The growth was found to be nearly checked at all stages, showing thereby that moisture available below the permanent wilting point was not enough to support the growth of the plants. Nevertheless it proved to be of much importance for their survival. Although the differences in soil moisture observed at the wilting stage of sugarcane plant were marked, at the time of its death these differences were very much minimized. This showed that one variety of sugarcane can not deplete the moisture of a soil to the same extent as another before wilting permanently. Similar results have also been reported by SLATYER[6] who observed that permanent wilting point may vary from species to species and within any one species with the variations in the osmotic characteristics of individual plant. It was found that, in all the varieties, the extent of water deficits in their shoot tissue at sunflower wilting (permanent wilting percentage) remained nearly the same but it varied from 63.25–68.65% and 37.55–43.12% at their wilting and death respectively.

It was noted that the interval between wilting of sunflower and wilting of sugarcane plant in Co. 859 amounted only to few days while in Co. 312, and Co.S. 510, it amounted to a longer duration followed by Co. 453 and Co.S. 416. Similar trends are also exhibited in the Figure which shows the time lag between wilting of sugarcane plant and its death. Co. 859 died 2 days after wilting, while Co. 312 and Co.S. 510 survived for 8 and 7 days respectively in a wilted condition. The ability of cane varieties to continue to live for different periods beyond the permanent wilting point may be either due to differences in their capacity to extract soil moisture below this limit, or differences in their critical and sublethal shoot tissue water deficits for their wilting and death respectively. ALWAY[9] reported that the moisture available between the limits of permanent wilting percentage and hygroscopic coefficient has a very high value for the maintenance of plant life. In regard to the responses of sugarcane varieties, Co. 859 appeared to be most sensitive to soil moisture stress followed by Co.S. 416 as compared to Co. 312, Co.S. 510 and Co. 453.



Time lag between sugar cane wilting and its death.

Zusammenfassung. Zuckerrüben können unterhalb des «Welkepunktes» überleben. Rassenunterschiede werden auf unterschiedliches Wasseraufnahmevermögen oder auf Unterschiede im Wassergehalt des Sprosses, bei welchem Welken eintritt, zurückgeführt.

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