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DETERMINATION OF PLOIDY LEVELS IN SUGAR BEET PLANTS

V. MORPHOLOGICAL CHARACTERS AS A TOOL OF PLOIDY LEVEL DETERMINATION IN SUGAR BEET PLANTS.

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ABSTRACT

Determination of ploidy levels is a common practice in sugar beet (Beta vulgaris L.) breeding and seed production. Many investigators have used deferent methods for ploidy determination in sugar beet. These methods include measurements of leaf stomatal size (length and diameter), stomatal density, chloroplast number in stomatal guard cells, pollen size and somatic chromosome counting. All these methods were conducted among a diploid population, and its equivalent triploid and tetraploid population.

The present investigation was carried out at Sabahia Agricultural Research Station, Alexandria, Egypt. The main objective was to use three morphological characters (Leaf blade length, Leaf blade width and Leaf disk weight) for determination of ploidy level in sugar beet plants, treated with three spindle fiber inhibitor reagents (8-hydroxyquinoline, para-dichlorobenzene and colchicine,) at the level of three different concentrations beside control to induce tetraploid sugar beet plants. Data showed that there were significant differences between the diploid and its counterpart's tetraploid plants in blade length and blade width characters, while in leaf disk weight no significant differences were found between the diploid and tetraploid sugar beet plants.

INTRODUCTION

Induction of polyploidy from a plant breeder's point of view, may originate new genetic combinations and providing breeders more variability (Blakeslee and Amos 1937). In nature, the majority of polyploids have arisen by sexual polyploidization through unreduced (2n) gametes (De Wet, 1982; Ramanna, 1992 and Ramsey and Schemske, 1998). However its production is genetically controlled (Bretagnolle and Thompson, 1995). Researches have been done using several chemicals product to study its effect for inducing polyploidy in different crops, and have been reported in cultivated plants such as potato (Peloquin *et al.*, 1992); (Ramanna and Jacobsen, 1992), sweet potato (Lopez-Lavalle and Orjeda, 2002) and (Ramanna and Jacobsen, 2003). Sugar beet commercial varieties varied in chromosome numbers after produced autotetrapliod beet (2n = 4X =36), by the end of 1930_s. Two types of polyploid were commercially produced anisoploids and triploid hybrids.

Kloen and Speckmann (1956) recognized that tetraploid beets grow somewhat slower physiologically. About the time of the longest day they yielded one or two leave less than the diploids. Tretyakova (1975) studied differences in morphological characters between tetraploid and diploid in sugar beet. He found that tetraploid plants have a short petiole, a smaller leaf surface area and shorter leaf area but wider leaf blades. Poschne (1982) found that diploid sugar beet plants tended to have more leaves but not greater foliage area than the polyploids. Foliage area and root yield were positively related, and there was a close negative correlation between foliage area and sugar content of the roots. Leaf area index and sugar

assimilation quotient, a measure of the rate of sugar assimilation per unit leaf area, were generally negatively correlated. The diploid variety combined small foliage area with high sugar yield/heact.

In Egypt, sugar beet is cultivated in 25,7667 feddans with an average production of about 18.593 tons per feddan 2007- 2008 (Annual Report of Sugar Crops Council, 2008). Sugar beet breeding program started in Egypt during the last two decades of past century by several investigator's and breeders, Younan (1984), El-Manhaly *et.al.* (1987), Saleh (1993), Ghura (1995), El-Manhaly *et.al.* (2004), Ghonema (2005) and Saleh *et.al.* (2008), at the Agric. Res. St., Alexandria, Sugar Crops Res. Inst. Agric. Res. Center, Egypt.

In the present investigation three morphological characters (Leaf blade length, Leaf blade width and Leaf disk weight) were used for determination of ploidy level in sugar beet plants treated with three spindle fiber inhibitors (8-hydroxyquinoline, para-dichlorobenzene and colchicine) at three concentrations to induce polyploidy.

MATERIALS AND METHODS

1.1. Sugar beet materials:

Sugar beet (*Beta vulgaris* L.) polygerm diploid breeding genotype (C39) obtained from Sugar Crops Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt and employed in this work.

1.2. Treatment:

Three spindle fiber inhibitors were used in this study. They are: (8-hydroxyquinoline, para-dichlorobenzene and colchicine) at the level of three concentrations beside control as shown in (Table, 1).

Table (1): Chemical compounds used for induction of polyploidy

Reagent	Concentration			
	Cont.	I	II	III
8-hydroxyquinoline	-	saturated solution (Oxy I)	1/2 saturated solution (Oxy II)	1/4 saturated solution (Oxy III)
Para-dichlorobenzine	-	saturated solution (Para I)	1/2 saturated solution (Para II)	1/4 saturated solution (Para III)
Colchicine	-	0.05% (Colch I)	0.02% (Colch II)	0.01% (Colch III)

2. Methods:

2.1. Induction of Polyploidy:

Seeds of sugar beet diploid breeding material (C39) were soaked in running tap water for 12 hours and then transferred for treatment reagents (8-hydroxyquinoline, para-dichlorobenzene and colchicine) at the examined concentrations for another 12 hours before planting on moistened cotton in Petri dishes. Seeds were allowed to germinate in an incubator at 23 C °.

Germinated seeds were transferred into plastic pots contained sandy clay soil 1:1 in three replicates for each treatment and kept in an incubator at the same degree until cotyledon leaves were appeared and then pots were transferred into open weather. Irrigation with polyploidy treatment was continued for three weeks after germination and then fresh water irrigation was started till the end of experiment.

2.2. Morphological examination

The observations and measurements were taken on treated plants from plastic pots after 45 days from planting date as follows:

- **Leaf blade length (cm):** length of the largest three leaves per plant was measured in cm.
- **Leaf blade width (cm):** width of the largest three leaves per plant was measured in cm.
- **Leaf disk weight (cm):** section of leaf with diameter 1 cm. was weighted to recognize the thickness of leaves after polyploidy treatment.

2. 3. Statistical analysis

The experimental design used was Randomized (C.R.D.) with three replicates, and the data were analyzed according to (Snedecor and Cochran, 1990).

RESULTS AND DISCUSSION

3.1. Morphological characters after polyploidy treatments:

Morphological characters were studied in treated plants after 45 days from planting. Figure (1) shows sugar beet plants after 45 days from polyploidy treatments. Three parameters were studied to determine the differences between treated plants:

3.1.1. Blade length:

Table (2) shows means of blade length character after polyploidy treatments at 45 days from planting. Data indicated that there were significant differences between the three studied treatments in blade length character. Highest value was found in 8-hydroxyquinoline treatment (6.6 cm.). There were significant differences between control and the three different studied concentrations. Significant differences were found also between interactions, highest value was found in second concentration (oxy II), while the lowest value was found in the control group. These results are in accordance with those obtained by Poschne (1982). He stated that diploid sugar beet plants tended to have more leaves but not greater foliage area than the polyploids.

3.1.2. Blade width:

Means of blade width character after treatments at 45 days from planting are given in (Table 3). There were significant differences between treatments, concentrations and between interactions. Highest value was found in 8-hydroxyquinoline treatment at the level of the second concentration (4.6 cm.). Such results are in a harmony with those obtained by Tretyakova (1975), who found that, tetraploid plants have a wider leaf blades.

3.1.3. Disk weight:

Leaf disks in (1cm.), diameter were weighted to reflect thinks of leaves after polyploidy treatments. Table (4) shows means of disk weight character after polyploidy treatment at 45 days from planting. No significant differences were found between the three studied treatments. The results are in agreement with those obtained by Rasmusson and Levan (1939) who demonstrated that thickness of the leaves seems to be a little greater in the polyploids.

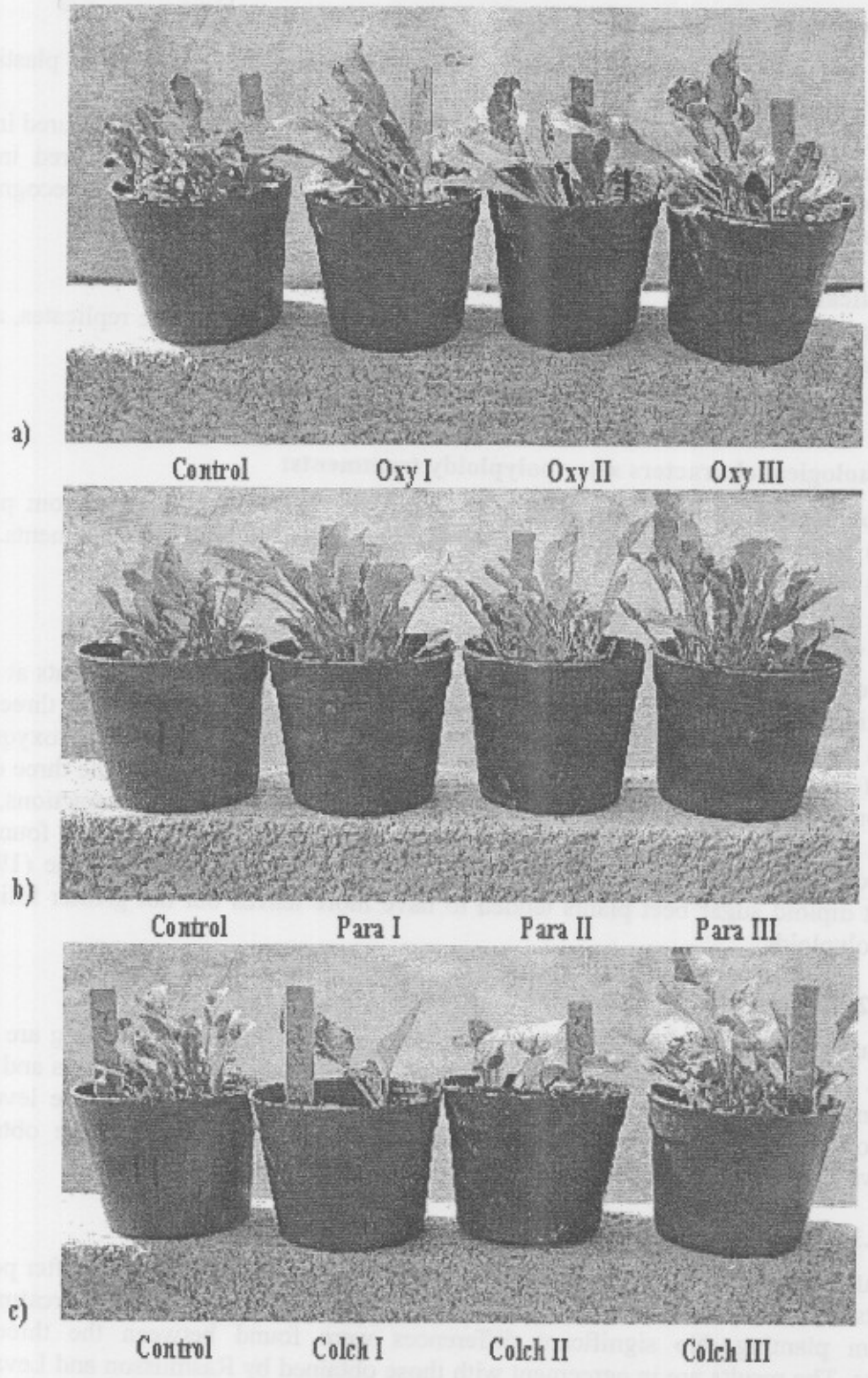

Figure (1): Sugar beet seedling after exposed different polyploidy treatments.

Table (2): Means of blade length character after polyploidy treatments at 45 days from plant age

Treatment \ Concentration	0	I	II	III	Mean
Oxy	4.87b	7.27a	7.30a	6.80a	6.60a
Para	5.80b	4.83b	4.90b	5.30b	5.20b
Colch	4.00b	6.30a	5.30b	4.40b	5.00b

Table (3): Means of blade width character after polyploidy treatments at 45 days of plant age

Treatment \ Concentration	0	I	II	III	Mean
Oxy	2.4d	2.9ab	4.6abc	3.9c	3.5a
Para	2.5d	2.5d	2.5d	3.0d	2.6b
Colch	2.4d	4.4bc	5.3a	4.4bc	4.1a

Table (4): Means of section weight after polyploidy treatments at 45 days from plant age

Treatment \ Concentration	0	I	II	III	Mean
Oxy	0.051a	0.069a	0.055a	0.051a	0.057a
Para	0.049a	0.058a	0.049a	0.055a	0.053a
Colch	0.052a	0.062a	0.055a	0.056a	0.056a

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الملخص العربي

تحديد مستويات تعدد المجموعة الكروموسومية فى نباتات بنجر السكر

٥- استخدام الصفات المورفولوجية فى تحديد مستويات تعدد المجموعة الكروموسومية

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أجرى هذا البحث فى محطة البحوث الزراعية بالصبحية بالإسكندرية ٢٠٠٨ والغرض الأساسى من هذا البحث هو دراسة استخدام ثلاثة من الصفات الخضرية (طول النصل – عرض النصل – وزن القطاع للورقة) وذلك فى تحديد درجة تعدد المجموعة الكروموسومية فى نباتات بنجر سكر حيث كان قد تم عمل تضاعف كروموسومى لها بإستخدام ثلاثة من المواد المطفرة هى

١ – ٨ هيدروكسى كينولين ٢ – باراداى كلوربنزين ٣ – كولشيسين

وقد استخدمت هذه المواد الثلاث فى ثلاثة تركيزات مختلفة بالإضافة إلى (الكنترول) لمعرفة التركيز الأمثل فى الحصول على أكبر نسبة من النباتات المتضاعفة وراثيا والتى لها ثبات عالى فى الإحتفاظ بهذه الصفة وهذه التركيزات هى:

١. التركيز الأول (محلول مشبع) وذلك فى حالة كل من (٨- هيدروكسى كينولين و باراداى كلوربنزين) وتركيز ٠,٠٥% فى حالة الكولشيسين.
٢. التركيز الثانى (محلول نصف مشبع) فى حالة من (٨ هيدروكسى كينولين و باراداى كلوربنزين) وتركيز ٠,٠٢% فى حالة الكولشيسين.
٣. التركسز الثالث (محلول ربع مشبع) فى حالة كل من (٨ هيدروكسى كينولين و باراداى كلوربنزين) وتركيز ٠,٠١% فى حالة الكولشيسين.
٤. الكنترول .

وقد أظهرت النتائج أن هناك فروق معنوية بين النباتات المعاملة والنباتات الغير معاملة فى كل من صفة طول النصل وصفة عرض النصل وذلك بالنسبة للمواد الثلاثة المستخدمة وأيضا بالنسبة للتركيزات الأربعة تحت الدراسة ولكن لم تكن هناك فروق معنوية فى صفة وزن القطاع فى الورقة سواء بالنسبة للمواد أو التركيزات المستخدمة.

مجلد المؤتمر السابع لتربية النبات– الإسكندرية ٤–٥ مايو ٢٠١١

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