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GENETIC RESPONSE OF HYBRID TOMATOES FOR PLANT REGENERATION .

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ABSTRACT : This study aimed to determine the genetic variability of tomato for plant regeneration as well as some trials for *in vitro* multiplication of some tomato hybrids . Three tomato cultivars and two hybrids were used to examine the influence of genetic background on callus and shoot formations . Callus was formed within 6 to 15 days . Shoot emerged either directly from explant or indirectly from callus. Comparison between different explants for callus induction on optimum media was studied . Elite hybrid Super StrainB (SSB) X Super Marmand (SM) possessed higher frequency of callus from the hypocotyl (85%) than the cotyledon and leaf (75% and 50% respectively) . The optimum groth regulators for callus proliferation was 0.1 mg/ l NAA + 2.0 mg/l Kinetin among the four combinations of hormone balance under study. Multiple adventitious shoots were formed by clonal propagation of somatic embryos in the presence of Kinetin at 2mg/l and 2ip at 0.5 mg/l as the best regulators among the four combinations of growth regulators under study . Shoot at length 1.5 to 3 cm was rooted on half strenght MS medium supplemented with 0.5 mg/l IBA. The plantlets were transferred to plastic pots containing on peat-moss : sand (1 :1 , V:V) and growing under mist on greenhouse. Different response between two hybrids and different three cultivars were detected for callus induction frequencies. These frequencies were 70% , 67% , 63% , 59.3% and 55% for SSB X SM , SSB X CR (Castlerock) , SSB , SM and CR respectively. Shoot regeneration was 75 % , 66.33 % , 58.67 %, 54% and 44.67% for

genotypes SSB X SM , SSB X CR , SSB , SM and CR respectively . The total number of regenerated shoots per seedling was 35.14 for SSB X SM hybrid while it was 26.39 for SSB X CR . The parental cultivars gave lower number of shoots per seedling than their hybrids , i.e. 19.49 , 14.56 and 9.83 for SSB , SM and CR respectively. Heterosis was cleared in shoot frequency i.e. 1.43 and 1.37 for SSB X CR and SSB X SM respectively. While callus frequency i.e. 1.14 and 1.13 for SSB X CR and SSB X SM respectively . The dominance effect played an important role for the genetic control of plant regeneration and SM cultivar possess a good combiner for plant regeneration ability .

Key words : Tissue culture – Tomato - Callus – Shoot regeneration – Genetic response – Heterosis – *Lycopersicon esculentum* .

NAA : Naphthaleneacetic acid .
2IP : Isopentenyladinine .
IBA: Indolbutyric acid .

INTRODUCTION

The primary goals of *in vitro* propagation of *tomato* include the clonal propagation of a large number of genetically identical plants (George and Sherrington 1984) . Production of virus-free plant material (Holdgate 1977) and crop improvement through various genetic techniques seems to be promising.

Since the early observation by Skoog and Miller (1957) that organogensis is regulated by the balance of auxin and cytokinin in the culture medium , much progress has been made in identifying factors that control plant morphogenesis. In earlier studies , attintion had been focused on determining the requirements of various plant growth with substances and nutrients for different organogenic processes (Murashige , 1974 and Gamborg *et al.* ,1977). More recently a number of investigations on organogenesis have been conducted from a physiological perspective to analyze various cellular processes associated with

organogenesis (Tran than van and Trinb 1986 and Thrope 1993) . Another way for increase of regeneration efficiency were identify of genotypic differences in plant regeneration capacity . Moghaieb *et al.*, 1999 studied the plant regeneration from hypocotyl and cotyledon of three tomato cultivars , i.e. , UC . 97 , Pontaroza and Zuishi . They reported that the highly signficant differences in shoot induction between cultivars were due to the genetic diffrences between them . The different effects of genotypes on callus and shoot formation were reported by many investigations (Kurtz and Lineberger , 1983 ; Schutze and Wieczorrek , 1987 ; Davis *et al.* , 1994 and Plastira et al 1997) .

Rare trials were carried for study of the inheritance of plant regeneration ability in tomato . Koornneef *et al.* , (1987) reported that the regeneration capacity from established callus culture of interspecific tomato hybrid (*Lycopersicon pervianum X L. esculentum*) was controlled by two dominnant genes and the genes controlling shoot regeneration in tomato were characterized and mapped by Koornneef *et al.*, (1993) . Therefore, the present study aimed to put up easy micropropagation protocols of elite tomato hybrids for solving of high cost of tomato hybrid seeds , as well as , prelimenary inheritance study of callus induction and plant regeneration in tissue culture of different tomato genotypes .

MATERIALS AND METHODS

This study was carried out during the period from 2001 to 2003 in Plant Biotechnology Res. Lab., Dept. of Genetics, Fac.Agric., Zagazig Univeristy.

I – Plant materials

Three different cultivars were used in the present study. The origin and characterization of them were shown in Table (1).

Crossing were made between five cultivars and six hybrids were obtained . The best two hybrids (SSB X SM and SSB X CR) were selected based on yield and yield component characters in the filed . All these tomato genotypes (two hybrids and its parental) were used in *in vitro* studies

II – Methods

a- Seed Sterilization

Tomato seeds were surface sterilized by 50 % commercial Colorox (contain 5.25%

sodiumhypochlorite) for 15 min then rinsed three times with sterilized distilled water . Aseptically seeds were transferred to 300ml glass jar containing 40 ml of solidified basal MS medium (Murashige and Skoog , 1962) . Culture medium was adjusted to pH 5.8 before autoclaving at 121 °C and 1.2 kg/cm^2 for 20 min . Cultures were then incubated at 25± °C for three days in darkness . The culture were transferred to growth chamber provide with 16 hr photoperiod (1000 – 2000 lux) and 8 hr dark .

b – Effect of growth regulators on callus induction

Ten days old aseptically growing seedling of hybrid SSB x SM was used as a source of explants . The different explants of this hybrid including hypocotyls, cotyledon and true leaf were excised aseptically . Five segments of each type of explant were plated on solid MS media containing different concentration of NAA and Kin . Culture media used for callus induction are :

1- MS + 2 mg/l Kin + 0.1 mg/l NAA .
2- MS + 2 mg/l Kin + 0.2 mg/l NAA .
3- MS + 2 mg/l Kin + 0.3 mg/l NAA .
4- MS + 2 mg/l Kin + 0.4 mg/l NAA .

In this experiment 20 replicates of each treatment were used .

C – Effect of growth regulators on plant regeneration

This experiment was conducted to investigate the effect of 2ip and kin on regeneration either directly from explant or indirectly from the embryonic callus .

Table (1) : The origin and characterization of the cultivars used in the present study .

Code	name	Origin	Characterization
SSB	Superstrain B	U.S.A	Determinate , very firm , processing , fresh market
SM	Super marmand	France	Semi-determinate , very firm , processing , fresh market
CR	Castlerock	U.S.A	Determinate , medium firm , heat tolerant , fresh market ...

Culture media used for plant regeneration as follows :

1- MS + 2.0 mg/l Kin + 0.5 mg/l 2ip .
2- MS + 2.0 mg/l Kin + 1.0 mg/l 2ip .
3- MS + 0.5 mg/l Kin + 2.0 mg/l 2ip .
4- MS + 1.0 mg/l Kin + 2.0 mg/l 2ip .

Ten replicates of each medium were prepared .

D – Effect of genotypes on morphogenesis

1- callus induction

Three cultivars and two hybrids under study were evaluated for callus induction on MS media containing 2 mg/l Kin + 0.1 mg/l NAA .

Callus frequency (%) was calculated as the following formulae :

$$\frac{\text{NO. of responsed explants for callus formation}}{\text{Total no. of explant}} \times 100$$

and callus fresh weight (mg) was calculated after one month age . In addition the heterosis were calculated also of callus frequency as the following formulae :

$$\frac{\text{F1 mean} - \text{parentals mean}}{\text{F1 mean}}$$

2- plant regeneration

Three cultivars and two hybrids under study were evaluated for plant regeneration on MS media containing 2mg/l Kin + 0.5 mg/l 2ip .

Shoot frequency (%) , was calculated as the following formulae :

$$\frac{\text{NO. of responsed callus for shoot formation}}{\text{Total no. callus}} \times 100$$

In addition the heterosis were calculated also of shoot frequency as the following formulae :

$$\frac{\text{F1 mean} - \text{parentals mean}}{\text{F1 mean}}$$

E – Statistical analysis

Data of callus and shoot frequency were analyzed by chi–square test (χ^2 test). In addition data of number of callus and shoot induction per seedling were analyzed by factorial experiment with two factors according to Gomiz and Gomez (1984) . Heritability and component of variation were calculated according to Single and Chaudhary (1977) .

RESULTS AND DISCUSSION

This study included two experiments .The first one aimed to determine the optimum hormone balance for callus induction and plant regeneration by using one elite and important hybrid (SSB x SM hybrid) and the second objected to determine the genetic response of five different genotypes three cultivars (SSB, SM and CR) and two hybrids (SSB X SM and SSB X CR) under one level of hormone balance for callus induction and plant regeneration ,as well as to determine some genetic parameters which belong to callus and shoot formations .

The results of the first experiments were classified into two categories:

1- The effect of growth regulators on callus induction

Callus frequency (%) were determined for various combinations of Kin and NAA on different explants , i.e., hypocotyls ,cotyledon and true leaf from SSB X SM tomato hybrid (Table 2) . Within 6-15 days, explants began to initiate callus tissues, firstly with the hypocotyls, followed cotyledon and leaf, respectively. Data obtained showed that MS medium supplemented with 2 mg /l Kin + 0.1 mg/l NAA gave the highest callus formation (70%) and significant difference between four combinations of hormone balance. Concentration of NAA increases the callus frequencies decreases and vice versa. On the other hand, the three types of explants, hypocotyls gave better callus formation (72.75%) followed by cotyledon (59.75%) and leaf explants (21.25%) respectively. In the same time ,hypocotyls possessed high significant callus frequency (85%) under 2 mg/l Kin + 0.1mg/l NAA .

The present results are in agreement with those obtained by Tall *et al.*, (1978). who obtained callus from root and stem explants of tomato on MS medium supplemented with 0.1mg/l NAA + 0.5mg/l Kin . In the same way Santana and Ramirez (1989) reported that the greatest callus growth was obtained with 1.0 mg/l Kin + 0.1 mg/l IAA from leaf explants of tomato .

These results completely disagree with the general rule of callus production from tomato suggested by Sink and Reynolds (1986) They recommended the use of high auxin concentrations in combination with low concentrations of cytokinin . These

differences may be due to one or all of the following considerations: (1) The different cultivars (i.e. different genotypes) used . (2) Many workers speculated that tomato had a high level of endogenous auxin, because shoot cultures produced roots easily without the addition of auxin (Sink and Keynolds ,1986 and Asakura *et al.*,1995). In general, auxins added to the medium to stimulate cell enlargement and cytokinins induced in the culture medium to enhance cell division (Torres ,1989). Regarding type of explants, Abo-shady *et al.*,1993 confirmed with the present results who showed that hypocotyl explant

Table 2 : Callus frequency (%) of various explant of tomato hybrid SSB X SM on MS media containing four concentrations of growth regulators .

Growth	**Explant**			**Mean**
regulator(mg/l)	Hypocotyl	Cotyledon	Leaf	
2Kin+0.4NAA	65	50	0	**38.33**
2Kin+0.3NAA	69	54	5	**42.67**
2Kin+0.2NAA	72	60	30	**54**
2Kin+0.1NAA	85	75	50	**70**
Mean	**72.75**	**59.75**	**21.25**	

Growth regulators effect

$\chi^2_C = 11.699$ $\chi^2_t = 7.815$

Explant effects

$\chi^2_C = 27.99$ $\chi^2_t = 5.991$

gave better callus proliferation compared with leaf and root explants .

In contrast results were suggested by Jawahar *et al.*, (1998) on tomato cv. PKMI and they reported that , frequency of callus induction increased with increasing concentration of auxins, the optimum levels being 2 mg / l IAA and 2 mg / l NAA in addition to the BA and Kinetin .

2- The effect of plant growth regulators on plant regeneration.

Derived callus from hypocotyls, cotyledon and leaf were transferred into MS medium supplemented with four different hormone balance (Table 3).

Significant differences between four treatments were recorded on the basis of plant regeneration frequencies.

MS medium containing of 2mg/l Kin +0.5 mg/l 2ip as well as, 2mg/l 2ip+0.5mg/l Kin gave higher shoot frequencies (75% and 72% respectively)than the other hormone balances.

Regarding the response of derived callus from different explants for shoot formation . highly significant difference of hypocotyls derived callus were showed for morphogenetic response than the other derived calli of cotyledon and leaf explants.

Shoot at length 1.5 to 3 cm was rooted on half strenght MS medium supplemented with 0.5 mg/l IBA. The plantlets were transferred to plastic pots containing on peat-moss : sand (1:1, V:V) and growing under mist on greenhouse.

All hormone balance tested contained cytokinines only successed in the shoot formation , because the excised tissue had a high level of endogenous auxin (Sink and keynolds, 1986).

These results confirmed with the findings of many researches (Abo-shady *et al.*,1993; Santana and Ramirez, 1989).

Plastira *et al.*, (1997) studied the effect of genotype and explant type in regeneration frequency of tomato . Who reported that BA and Zeatin at 0.1-10 mg/l induced multiple shoot regeneration. but only toper hypocotyls responded to Kinetin in the culture medium. Regeneration frequency from different explants was in the following order hypocotyls > cotyledon > leaf .

The second experiment aimed to study the genetic response of different genotypes especially hybrids as well as knoweledge of some sort of genetic behaviour for callus induction and plant regeneration ability .

No significant differences between genotypes for callus frequency over all explant were detected . In contrast , significant differences betweeen three explants were showed for callus

frequency (Table 4) . Hypocotyl gave highest callus frequency (77.6%) followed by cotyledon (70.2%) and leaf (40.8%) respectively .

Regarding average fresh weight ; large differences occurred between genotypes (Table 5) . The better callus weight was SSB X SM hybrid followed by SSB X CR hybrid , while the cultivares gave light weight of callus . these results confirmed the hybrid vigor for average callus fresh weight of in two hybrids . Regarding various explants , cotyledon explant gave heavy weight of callus , followed by hypocotyl and leaf respectively.

Highly differences between genotypes occurred for shoot frequency (%) Table 6 . SSB X SM followed by SSB X CR hybrids possessed higher shoot frequency than the its parents . In the same way , highly differences occurred also between various explants for shoot frequency . Hypocotyl gave higher shoot frequency , followed by cotyledon and leaf respectively .

Higher percentage of shoot frequency (90%) occured in combination between best genotype (SSB X SM hybrid) and best explant (hypocotyl, Table 6) .

Average number of shoot per seedling is considered as a important character for successed of reproduction of tomato hybrids by using tissue culture .

Table 3 : Shoot frequency (%) of various explant of tomato hybrid SSB X SM on MS media containing four concentrations of growth regulators .

Growth	**Explant**			**Mean**
regulator(mg/l)	Hypocotyl	Cotyledon	Leaf	
2 Kin+0.5 2ip	90	75	60	**75**
2 Kin+1.0 2ip	64	51	34	**49.6**
2 2ip+0.5 Kin	86	70	60	**72**
2 2ip+1.0 Kin	71	45	25	**47**
Mean	**77.75**	**60.25**	**44.75**	

Growth regulator effect

$\chi^2_c = 10.555$ $\chi^2_t = 7.815$

Explant effects

$\chi^2_c = 8.952$ $\chi^2_t = 5.991$

Table 4 : Callus frequency (%) of three different explant of five genotypes of tomato on MS media containing 2 mg / l Kin + 0.1 mg / l NAA .

Genotype	**Explant**			**Mean**
	Hypocotyl	Cotyledon	Leaf	
SSB	78	70	41	**63**
SM	75	68	35	**59.3**
CR	70	65	30	**55**
SSB X SM	85	75	50	**70**
SSB X CR	80	73	48	**67**
Mean	**77.6**	**70.2**	**40.8**	

Genotype effect

$\chi^2_c = 2.26$ $\chi^2_t = 9.488$

Explant effects

$\chi^2_c = 12.055$ $\chi^2_t = 5.991$

Heterosis

SSB X SM = 1.13

SSB X CR = 1.14

Table 5 : Callus fresh weight (mg) of various explant of five genotypes of tomato on MS media containing 2 mg / l Kin + 0.1 mg / l NAA

Genotype	***Explant***			***Mean***
	Hypocotyl	Cotyledon	Leaf	
SSB	586	654	230	**490**
SM	483	720	224	**475.67**
CR	495	632	196	**441**
SSB X SM	640	792	462	**632.67**
SSB XCR	621	701	431	**584.33**
Mean	**565**	**699.8**	**308.6**	

Genotype effect

$\chi^2_c = 49.2$ $\chi^2_t = 9.488$

Explant effects

$\chi^2_c = 150.05$ $\chi^2_t = 5.991$

Table 6 : Shoot frequency (%) of various explant of five genotypes of tomato on MS media containing 2 mg / l Kin + 0.5 mg / l 2ip .

Genotype	**Explant**			**Mean**
	Hypocotyl	Cotyledon	Leaf	
SSB	78	53	45	**58.67**
SM	71	48	43	**54**
CR	62	39	33	**44.67**
SSB X SM	90	75	60	**75**
SSB X CR	85	60	54	**66.33**
Mean	**77.2**	**55**	**47**	

Genotype effect
$\chi^2_c = 9.948$ $\chi^2_t = 9.488$
Explant effects
$\chi^2_c = 8.197$ $\chi^2_t = 5.991$
Heterosis
SSB X SM = 1.37
SSB X CR = 1.43

Analysis of variance of average number of callus per seedling and average number of shoot per seedling are shown in (Table 7) .

Highly significant differences between genotypes, explants and interaction between genotype X explant occurred for average number of callus per seedling and average number of shoot per seedling , except the interaction of average number of callus per seedling gave significantly . These results confirm that the possibility of genetic improvement of plant regeneration ability for obtaining of hybrid tomato possess highly regeneration ability , by calloboration between genetics and plant researches on explant kinds and hormone balance . Moreover highly heritability in broad- sense , i.e., 96.75 and 98.60 for avearge number of callus per seedling and average number of shoots per seedling, respectively . Confirm the above conclusion , that plant regeneration ability is more genetically controlled than the environmental factors . Heterosis of two hybrids under study were possitive and higher than the mid-parents for two criteria (Table 8).

Highly heterosis occurred for average number of shoots per seedling , which were more than twice of the mid-parents (figure 1,2) . This finding confirm that the dominance effect play an important role in the genetic control of plant generation ability than the additive effect and also confirming the possibilty of tomatos hybrid reproduction via tissue culture technique . Comparison between hybrids and their parents for number of shoots per seedling showed that the promising of SSB X SM and SSB X CR hybrids gave (35.14 and 36.35, respectively) higher shoots number than SSB better parent (19.49) The data illustrated in (Table 8) . These results confirm that the SM cultivar consider as a good combiner for plant regeneration ability. These results were in agreement whith the many investigators . Regarding callus proliferation , many investigation confirmed with the present results (Encina *et al.*, (1990) and Ali and Li ,(1994) .

Three *Lecopersicon esculantum* varieties , *L. pimpinellifolium* and F_1 interspecific hybrids between each of the three cultivated varieties and *L . pimpinellifolium* were cultured on MS medium with different concentrations of kinetin and IAA were studied by Nguen *et al.*, (1991) .They reported that among of the three varieties , Likurich had the widest response in terms of callus development.

L. pimpinellifolium needed lower doses of the growth regulators for callus formation than the cultivars , and had lower callus growth .

Regarding of plant regeneration ability , many investigations reported that widely genetic responses of different genotypes were marked for plant regeneration in tomato (Kurtz and linebrger , 1983; Uddin *et al* .1988 ; Yurkova and Galetskaya,1990 ; Nguen *et al.*, 1991 and El-Farash *et al.*,1993) . Similar results were obtained by moghaieb *et al.*,(1999). They studied the effect of genetic background on the regeneration efficiency of three tomato cultivars (UC-97 , Pontaroza and Zuishi) . Highly significant differences were recorded in shoot induction between cultivars. .

The regeneration frequency was 57.2 , 34.5 and 35.5 for UC-97 , Pontaroza and Zuishi , respectively. On the other hand , Chandra *et al.*, (1995) studied *in vitro* regeneration of hybrid and

non-hybrid tomato (*L . esculantum* L) . The hybrid variety (posa sheetal) produced more shoot buds than the non-hybrid varieties (PH1 and PH2). Inheritance of plant regeneration ability were studied by several investigators . Faria and Illg , (1996) used wild *Lecopersicon pimpinellifolium* , with high *in vitro* plant regeneration ability , was crossed as pollen donor with 5 recaleitrant *L. esculantum* genotypes . F_1 hybrid showed a dominance effect ; no differences were observed in reciprocal crosses . The F_2 rate was close to 9R : 7NR . The results suggest an interaction of two dominant genes ; indicating that the transfer of high plant regeneration ability from to commercial varieties would be relatively easy , since a qualitatively inherited dominant trait is involved. Another important way on plant regeneration frequency , chromosome constitution was studied in plant regeneration from cultured hypocotyl tissue of tomato (*L. esculantum*) . Amajority (85.3 %) of regerants from apical end of hypocotyl pieces were diploids . On the other hand , a high level (67.9%) of polyploidy and mixoploidy was found among the regenerants from the basal end (Asakura *et al* ., 1995) . They found that the basal end contained , on average , 14 pg of IAA per hypocotyl piece , while no IAA was detected in the apical end . Only diploids were regenerated from the basal end on medium supplemented with kinetin . These ruselts suggest that : (1) a high amount of endogenous auxin resulting from the basipetal polar transport play a role in the induction of polyploidy ; and (2) a type of exogenous cytokinin affects the frequency of polyploidization in the presence of auxin. This suggest the usefulness of hypocotyl tissues for *in vitro* production of plants with a normal chromosome constitution in tomato .

Recent researches were achieved by several invistigators . Soniya *et al*., 2001 , examined the genetic stability in tissue cultured tomato plants by randomly ampilified polymorphic DNA (RAPD) analysis . Calluses were induced from leaf explants . Regeneration was obtained after culturing freshly– induced calluses on MS medium containing 17.7μM BA alone . Microshoots were rooted in the presence of 10 μM IBA on MS medium . The

estimation of genetic similarity coefficient based on RAPD band . Sharing data indecated that ten regenerated plants were more than 95% similar to the mother plant , except one , LS5 , which was found to be distinctly different . This report demonstrates the feasibility of easy induction of regenerative calluses by using combination of picloram and BA and the possibility of detecting genetic variation through RAPD analysis among callus and regenerated plants in tomato at an early stage of growth . Another study achieved gene transfer in the wild tomato *in vitro* plant regeneration by using agrobacterium – mediated transformation to intoduce the npt11 and uidA marker genes into the salt tolerant accession LA 1401 The inheritance analysis showed a Mendelian segregation of both transgenes . The collection of transgenic plants will be an useful tool in experiments of asymatric somatic hybridization with *L. esculantum* (Arrillaga *et al* ., 2001) .

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Table 7 : Mean square and heritability inbroad-sense (h^2) of average No.of callus/seedling and average No.of shoots/seedling for five genotypes .

S.O.V	d.f	Average No. of callus/seedling		Average No. of shoot/seedling	
		MS	h^2	MS	h^2
Replication	2	$0.005^{n.s}$		$0.035^{n.s}$	
Treatment	14	5.21^{**}		66.63^{**}	
Genotypes(A)	4	0.564^{**}	96.75	99.28**	98.6
Explant(B)	2	34.83^{**}		238.2**	
A X B	8	0.1375^{*}		8.88**	
Error	28	0.058		0.345	

n.s non significant * significant at 0.05 ** significant at 0.01

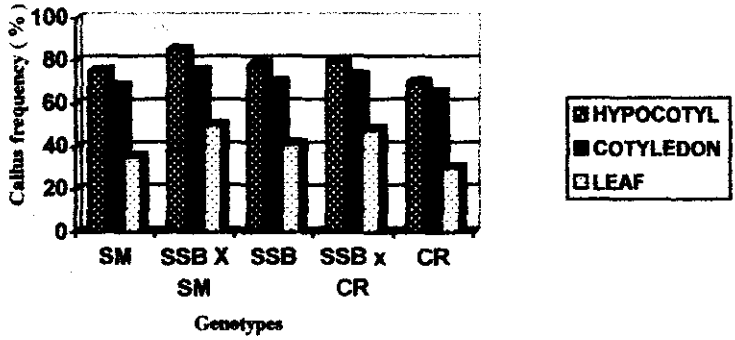

Fig 1 :Callus frequency (%) of three different explant of five tomato genotype on MS containing 2 mg / l Kin + 0.1 mg/l NAA .

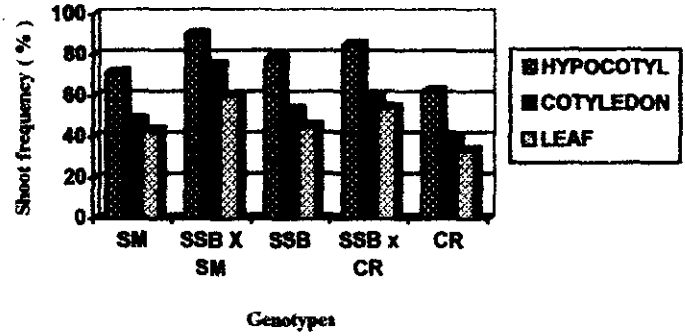

Fig 2: Shoot frequency (%) of three different explant of five tomato genotype on MS containing 2 mg / l Kin + 0.5 mg/l 2ip .

Table 8 : Agerage callus and shoot numbers per seedling for five genotypes of tomato and heterosis of hybrids .

Genotype	*Average no. of callus / seedling*					*Average no. of shoots / seedling*				
	Hypocotyl	Cotyledon	Leaf	Total	Mean	Hypocotyl	Cotyledon	Leaf	Total	Mean
SSBXSM	5.1	3.0	2.0	10.1	3.4	16.06	14.4	4.68	35.14	11.7
SSBXCR	4.8	2.92	1.92	9.64	3.2	12.6	10.16	3.63	26.35	8.8
SSB	4.68	2.8	1.64	9.12	3.04	9.85	7.57	2.07	19.49	6.5
SM	4.5	2.72	1.4	8.62	2.87	7,03	6.27	1.26	14.56	4.85
CR	4.2	2.6	1.2	8.0	2.67	4.68	4.16	0.99	9.83	3.27
Total	23.28	14.04	8.16	45.48		50.22	42.56	12.63	105.37	
Mean	4.656	2.808	1.632	9.096		10.044	8.512	2.526	21.074	
L.S.D 0.05			0.403							0.98
Heterosis										
SSBXSM			13.87							106.3
SSBXCR			12.61							116.16

الاستجابة الوراثيه لهجن الطماطم لقدرتها على إنتاج نباتات طماطم معمليا .

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اشتملت هذه الدراسة على عمل إكثار معملى لبعض هجن الطماطم بالاضافه الى تقدير الاختلافات الوراثية لقدرة نبات الطماطم على التكشف معمليا . وقد تم استخدام ثلاثة أصناف و اثنين من هجنها لدراسة الاختلافات الوراثية بالنسبة لتكوين الكالس و الأفرع بزراعة الانسجه . تم الحصول على الكالس خلال ٦ إلى ١٥ يوم . وكانت أفضل بيئة لانتاج الكالس هى بيئة موراشيج و سكوج بالاضافة إلى ٢مجم/ لتر كينيتين + ٠,١ نفثالين حامض الخليك . بينما النموات الخضريه تكونت عند زراعة الكالوسات على بيئة موراشيج و سكوج مضافا اليها ٢ مجم / لتر كينيتن + ٠,٥ مجم / لتر ٢- ايزوبينتينيل ادينين . كونت هذه الاشطاء جذور عند نقلها على بيئه موراشيج و سكوج بنصف التركيز بالاضافة الى ٠,٥ اندول حامض البيوتريك. وقد وجد اختلاف بين الطرز الوراثية بالنسبة لتكرارات تكوين الكالس حيث اظهر الهجين سوبر سترين بى X سوبر مارماند (٧٠ %) على نسبه عن باقى الطرز الوراثية الآخرى ، و أظهر أيضا أعلى نسبه فى إنتاج الأشطاء (٧٥ %) .وكان عدد الاشطاء لكل بادره هو ٣٥,١٤ للهجين سوبر سترين بى X سوبر مارماند ، بينما الهجين سوبر سترين بى X كاسل روك أعطى ٢٦,٣٩ نمو خضرى لكل بادره ، بينما الأصناف سوبر سترين بى و سوبر مارماند و كاسل روك فقد أعطت ١٩,٤٩ ، ١٤,٥٦ ، ٩,٨٣ نمو خضرى لكل بذرة على الترتيب .وهذه الدراسة أوضحت الدور الهام للتاثير السيادى بالنسبه للتحكم الوراثى فى عملية التكشف .