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PRODUCTIVITY AND ECONOMIC EFFICIENCY OF APPLICATION INDUCED RESISTANCE TECHNIQUE IN AUTUMN TOMATO PRODUCTION.

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ABSTRACT

This study came out as results of many preceding primary studies from 1995 to 2004 years on chemical induced resistance as preventive technique from Insect born viruses diseases, this experiment was conducted For two fall season from 2005- 2006, in newly reclaimed sandy soil. Seeds of four tomato commercial F1 hybrids were sown in foam try on May 1st in the two season. On 15th June seedling were transplanted into field. On the day of transplanting, half of seedling were foliar treated with complex chemical induced resistance compound and repeated every 15 days.

Data of Disease incidence, average fruit weight, fruit taste index, early yield, total yield and marketable yield were recorded. All recorded data were subject to statistical analysis by SAS computer program. More over, data of production costs, net return and other economic indicator was collected by questioner method on tomato growers in the investigated region.

The results showed that all recorded data were improved significantly by chemical induction of resistance in all four cultivars through both growing season. Meanwhile, the response rate was differed up on cultivars and its base resistance level. Up on the results, it could be concluded that, the application of chemical induction of resistance not only prevent the viruses diseases infection, development and effects in tomato but also improve productivity, fruit quality and also, increasing both grower returne and consumer buying ability. So it could be the ideal solution to control insect born viruses such as Tobacco mosaic virus (TMV) and cucumber mosaic virus (CMV) in fall tomato.

Keywords: Production Economics, Tomatoes, Disease incidence, Productivity, Earliness, Fruit quality, Induced resistance, Insect born viruses diseases

INTRODUCTION

Tomato is one of the most important vegetable crop in Egypt. It's grown all year round in Egypt in about 473 thousand Feddan average of 2003-2005. The fall cultivated area was about 69.77 thousand Feddan in the same period with percentage of 14.75% of total tomato cultivated area around year. Average yield of fall tomatoes was 16.55 ton / Feddan in 2003-2005 with total product in of about 1.152 million ton, with percentage of 14.9 % of total tomato production around year. As for Egyptian annual tomato consumption it was 6.07 million ton a year, with average of 75.5 kg/ person a year (MALR 2003- 2005). However, tomato production faces some problems in fall season due to high temperature and insect born viruses diseases prevailing in these months. The main effect of adverse weather conditions was found on flowering and fruit set. So cultivation of heat tolerant cultivars

could come over the problem of flowering and fruit set depression (Abdel-Baki 1991, Dane et.al., 1991, Mahasen et.al.,1994 and Glala et.al.,2005). But heat tolerant hybrids are almost sensitive to insect born viruses such as Tobacco mosaic virus (TMV) and cucumber mosaic virus (CMV). which resulted in an estimated at least 25% yield loss. Also insect born viruses is a particularly difficult to manage, due in part to its extensive host range and ability to be transmitted by more than 65 insects species. Moreover, there is a lack of genetically resistant fresh-market tomato varieties to CMV infection, so management options are limited (Zehnder et.al.,1998 and Glala et.al., 2005). Thus, most of fall tomato growers consume a huge amount of insecticide to prevent viruses transmitted by aphids or whit fly specially in the first 40 days after transplanting (up to fruit set). the huge amount of insecticide affected significantly both earliness and total yield and may also influence both grower and consumer health (Glala et.al., 2005).

Zehnder et.al, (1998), stout et.al, (1998&1999) Anfoka (2000), Salem (2004) and Glala et.al., (2005) reported that insect born viruses such as Tobacco mosaic virus (TMV) and cucumber mosaic virus (CMV) could be well controlled by applying induced resistance (IR) even by biological or chemical inducer.

Moreover Glala et.al., (2005) reported that the application of chemical induction of resistance not only reduce the viruses diseases infection, development and effects in tomato but also improve plant growth, productivity, earliness and fruit quality. Ye et.al., (1995) and Glala et.al., (2005), mentioned that the application of chemical induction of resistance could be involved in integrity pest management programs for controling insect born viruses such as Tobacco mosaic virus (TMV) and cucumber mosaic virus (CMV) in fall tomato.

Therefore, this study, aims to investigate the economic influence of applying chemically induced resistance technique by fall tomato growers under open field conditions in the fall season, as approach of applying the phenomena (SAR) in vegetable production in order to reduce using pesticide and its side effect in both grower consumer health. Thus, fall tomato growers could found an alternative management strategies, environmentally sound and easily implemented.

MATERIAL AND METHODS

This pilot study came out as results of preceding studies on the influence of induced resistance application on tomato during 2003-2004 years, it was conducted For two fall season from 2005- 2006, in newly reclaimed sandy soil, El-Khatatba, Menofia Governorate. Seeds of the most popular four tomato commercial F1 hybrids (GS12, Alisa, VT737 and SS33) in fall season were sown "in foam try filed with growing media of 1 peat : 1Vermeculite" on May 1st in both season. On June 15th seedling were transplanted into field. On the day of transplanting the seedling were treated with chemical solution for systemic resistance induction, and repeated every

15 days four time up to 45 days after transplanting in comparison with clear water as control treatment.

A large scale area was treated in many private farm to follow up the economic influence of the new strategy in comparison with the traditional cultivation practices for fall season through two growing season.

The level of the resistance induced in tomato plants against the viruses disease was recorded after 50 days after transplanting as the percentage of plants that developed chlorosis and mosaic symptoms (Disease incidence) (Glala et al., 2005), average fruit weight, fruit taste (paneled taste), early yield, total yield and marketable yield were calculated.

Data were subject to statistical analysis of ANOVA, and the entries means were compared according to Duncan multiple comparative methods, as reported by(Gomez and Gomez, 1984) All statistical process were processed by SAS computer program.

Moreover, the economic study was conducted depending on a questioner method for random sample consisted of 48 adopted growers of the new technique "12 grower for each investigated cultivar" and 48 non-adopted growers (traditional technique) "12 grower for each investigated cultivar" from El-Khatatba region during 2005 and 2006 seasons. The collected data were analyzed using quantitive and qualitative statistical analysis methods. More the most important economic indicators were calculated to find out the economic efficiency of induced resistance technique.

RESULTS AND DISCUSSION

1- Diseases incidence:

1.1- Effect of cultivars:

As shown in Table (1), data of the percentage of plants that developed chlorosis and mosaic symptoms (Disease incidence), reflected that, cultivars differed significantly regarding their reaction to viruses diseases, and resistance induction where Vt737 showed the highest resistance ability followed by SS33, Alisa and then GS12 hybrids. In contrary GS12 and Alisa showed the greatest response to chemical induction of resistance in comparison with SS33 and VT737 F1 hybrid. These trend was true in both two seasons with high significant differences.

1.2- Effect of Treatments:

From the abovementioned data, the systemic resistance induction treatment resulted in the lowest percentage of plants that developed chlorosis and mosaic symptoms (disease incidence). An opposite trend was recorded for control. The difference among treatment were very high significant in all cases for two seasons.

Regarding the improvement of plant health (disease incidence), its clear to notice that the chemical induction of resistance treatment was the most effective in this regard in comparison with cultivars. On other hand GS12 and Alisa F1 hybrids responded to foliar treatment greater than VT 737

and SS33. these trends agree with those reported by Doubrava et.al., (1988) Gottstein et.al., (1989), Cohen et.al.,(1994), Kessmann et.al., (1994), Zehnder et. Al.,(1998), Anfoka (2000), Salem (2004) and Glala et.al., (2005).

Table (1) : Response of diseases index and some fruit properties to chemical induction of systematic resistance in of some tomato cultivars.

Cultivars	Treatments	First Season 2005			Second Season 2006		
		Virus infection (%)	Mean fruit weight (g)	Taste index	Virus infection (%)	Mean fruit weight (g)	Taste index
GS12	SAR treat.	29.93 CD	82.27 B	8.40 A	22.97 E	91.47 B	10.49 A
	Control	63.17 A	62.87 D	8.32 A	58.27 B	59.53 E	10.55 A
GS12 mean		46.55 A	72.57 B	8.36 A	40.62 A	75.50 C	10.52 A
Alisa	SAR treat	24.17 DE	88.50 A	7.56 B	21.37 E	92.37 B	8.73 BC
	Control	58.87A	63.03 D	7.67 B	65.10 A	66.3 D	9.6 AB
Alisa mean		41.52 A	75.77 AB	7.62 B	43.23 A	79.35 B	9.05 B
VT737	SAR treat	20.03 E	89.03 A	6.40 D	17.43 E	95.53 A	6.91 D
	Control	32.30 BC	69.63 C	6.89 CD	31.87 D	72.37 C	8.12 BCD
VT737 mean		26.17 B	79.33 A	6.65 C	24.65 B	83.95 A	7.52 C
SS33	SAR treat	21.23 E	85.73 AB	7.61 B	18.23 E	95.77 A	7.48 CD
	Control	37.57 B	69.70 C	7.25 BC	39.47 C	70.83 C	8.51 BC
SS33 mean		29.40 B	77.72 A	7.43 B	28.85 B	83.30 A	8.00 C
Treatments Means	SAR treat	23.84 B	86.38 A	7.49 A	20.00 B	93.78 A	8.40 B
	Control	47.98 A	66.31 B	7.53 A	48.68 A	67.27 B	9.13 A
Significant levels	Cultivar	***	**	***	***	***	***
	Treatments	***	***	NS	***	***	*
	Interaction	***	***	***	***	***	***

NS= Non Significant * = Significant at 5 % **= Significant at 1 %
***= Significant at < 0.1 %**

Economic and Productivity Efficiency of Fall Tomato Grower:
The area unite productivity :

Table (2) showing the productivity of different cultivar under the two production protocol as ton / faddan.

Data in table (2) revealed that the faddan productivity increased by applying the induced resistance protocol by 65.2%, 66.3%, 42.3% and 46.3% comparing with the traditional protocol for Gs12, Alisa, VT737 and SS33 cultivar respectively in 2005 season, and by 57.4%, 67.8%, 40.7% and 43.5% for the same cultivar respectively in 2006 season.

Regarding to unmarketable yield the data also showed that, unmarketable yield percent was decreased when induced resistance applied, where it was 7.01%, 8.92%, 10.17 and 7.39% for GS12, Alisa, VT737 and SS33 cultivars respectively comparing with 11.34%, 14.96%, 11.62% and 10.15% when traditional proceeding were followed in the four cultivars respectively.

As for early yield, the data proved that using induced resistance strategy in fall tomato season, resulted in increasing the early yield percent up to 49.5%, 42.4%, 36.1% and 34.7% in GS12, Alisa, VT 737 and SS33

cultivar respectively, out of 21.042, 20.665, 19.872 and 20.192 ton / faddan. Comparing with 33.6%, 24.3%, 29.5% and 35.1% for the same cultivar respectively, when traditional pest control method was applied in 2005 season. Similar trend was obtained in 2006 season also.

The variable cost / Feddan :

The effect of applying induced resistance protocol on the production cost of tomato were investigated and tabulated in Table (3).

Data in table (3) proved that, using of induced resistance protocol resulted in decreasing the variable cost of fall tomato production Feddan from 10960, 11060, 11435 and 11415 LE to 6690, 6840, 7105 and 7115 LE for GS12, Alisa, VT 737 and SS33 cultivars respectively in 2005 season. By other words, the decreasing percent catches of the variable cost 38-39% in all cultivars used in this investigation in 2005 season. The same trend was obtained in 2006 season with decreasing percent of 37-38%.

Table (2) : Response of some yield properties to chemical induction of systematic in some tomato cultivars resistance.

Cultivars	Treatments	First Season 2005			Second Season 2006		
		Total yield (ton /Fed)	Early yield (ton /Fed)	Marketable yield (ton /Fed)	Total yield (ton /Fed)	Early yield (ton /Fed)	Marketable yield (ton /Fed)
GS12	SAR treat	22.899 A	10.415 A	21.042 A	25.953 AB	11.800 A	24.133 A
	Control	13.860 C	3.928 D	11.684 D	16.487 D	4.097 E	14.617 D
GS12 mean		18.379 A	7.172 A	16.363 A	21.220 A	7.949 A	19.380 A
Alisa	SAR treat	23.475 A	8.769 B	20.665 AB	26.632 A	10.007 B	24.257 A
	Control	14.115 C	3.151 E	12.956 C	15.871 D	3.757 F	13.497 D
Alisa mean		18.795 A	5.960 B	16.811A	21.252 A	6.882 A	18.877 A
VT737	SAR treat	22.521 A	7.173 C	19.872 B	25.859 AB	8.977 C	23.230 B
	Control	15.758 B	3.954 D	13.387 C	18.376 C	5.517 D	16.240 C
VT737 mean		19.140 A	5.564 B	16.630 A	22.118A	7.247 A	19.735 A
SS33	SAR treat	22.792 A	6.998 C	20.192 AB	25.594 B	9.110 C	23.703 AB
	Control	15.578 B	4.359 D	13.827 C	17.840 C	5.373 D	15.993 C
SS33 mean		19.185 A	5.679 B	17.010 A	21.717 A	7.242 A	19.848 A
Treatments Means	SAR treat	22.922 A	8.338 A	20.443 A	26.010 A	9.974A	23.831 A
	Control	14.828 B	3.848 B	12.964 B	17.143 B	4.686 B	15.087 B
Significant levels	Cultivar	NS	*	NS	NS	NS	NS
	Treatments	***	**	***	***	***	***
	Interaction	***	***	***	***	***	***

NS= Non Significant *** = Significant at 5 %** ****= Significant at 1 %**
*****= Significant at < 0.1 %**

The decreasing in production cost was mainly due to decreasing of pest control where it was about 1050 LE /Feddan, by using of induced resistance protocol, comparing with 5600 LE /Feddan when traditional protocol was applied recording decrease percent of 81.25% in both growing seasons.

The cost of production unite "Ton":

Cost of one ton tomato was calculated for all investigated cultivars and treatments, and revealed that, the using of induced resistance technique resulted in decreasing of production cost/ ton up to one third of its production

cost, by following traditional technique. Where the recorded values were 33.9%, 38.8%, 41.2% and 42.6% of its costs when traditional technique was applied on GS12, Alisa, VT 737 and SS33 cultivars respectively in 2005 season. Similar trend was obtained in 2006 season.

Table (3): Production costs and economic indicator of fall tomato growers for investigated samples in 2005 and 2006 seasons.

inputs	2005							
	Control (Traditional technique)				SAR treatment (New technique)			
	GS12	Alisa	VT737	SS33	GS12	Alisa	VT737	SS33
Seedling	720	840	1125	1125	720	840	1125	1125
Machinery (1)	1100	1100	1100	1100	1100	1100	1100	1100
Labor wages(2)	1440	1420	1510	1490	1720	1750	1730	1740
Pest control practices								
Machinery	400	400	400	400	75	75	75	75
Labor wages	1200	1200	1200	1200	225	225	225	225
Pesticides	4000	4000	4000	4000	750	750	750	750
Manure	900	900	900	900	900	900	900	900
Fertilizers	1200	1200	1200	1200	1200	1200	1200	1200
Variable costs	10960	11060	11435	11415	6690	6840	7105	7115
Total costs	11860	11960	12335	12315	7590	7740	8005	8015
Revenue								
Early yield	4843	3523	4456	5564	12842	9804	8084	8013
Rest yield	8361	10442	10112	9712	11456	12669	13613	14289
Total revenue	13204	13965	14568	15276	24298	22473	21697	22302
Net returns	1344	2005	2233	2961	16708	14733	13692	14287
Revenue/ costs	1.11	1.17	1.18	1.24	3.20	2.90	2.71	2.78
inputs	2006							
	Control (Traditional technique)				SAR treatment (New technique)			
	GS12	Alisa	VT737	SS33	GS12	Alisa	VT737	SS33
Seedling	760	890	1145	1155	760	890	1145	1155
Machinery (1)	1100	1100	1100	1100	1100	1100	1100	1100
Labor wages(2)	1540	1500	1580	1550	1830	1840	1830	1840
Pest control practices								
Machinery	400	400	400	400	75	75	75	75
Labor wages	1200	1200	1200	1200	225	225	225	225
Pesticides	4000	4000	4000	4000	750	750	750	750
Manure	900	900	900	900	900	900	900	900
Fertilizers	1200	1200	1200	1200	1200	1200	1200	1200
Variable costs	11100	11190	11525	11505	6840	6980	7225	7245
Total costs	12000	12090	12425	12405	7740	7880	8125	8145
Revenue								
Early yield	5326	4396	6069	5749	15340	11708	9875	9748
Rest yield	12098	10227	10937	10408	14183	14962	14538	14301
Total revenue	17424	14623	17006	16157	29523	26670	24413	24049
Net returns	5424	2533	4581	3752	21783	18790	162883.0	15904
Revenue/ costs	1.45	1.21	1.37	1.30	3.82	3.38	0	2.95

Net Return /Feddan.

The indication of net return was calculate and revealed that, net return was increased when induced resistance strategy was followed. The

increasing rate was differ up on the cultivars, where it recorded about 1243% in GS12 cultivar, meanwhile, it was 483% in SS33 cultivar in 2005 season. However, the increase in the net return in 2006 season recorded its highest value "742%" in Alisa cultivar and its lowest value "356%" in VT737 cultivars. The increasing of net return / Feddan was mainly due to increasing of both total yield and early yield when induced resistance strategy was followed.

Total Return /Cost Ratio:

When induced resistance protocol was applied, the return / cost ratio was increased comparing with traditional production proceeding in all investigated cultivars and seasons. Where it recorded 3.2, 2.9, 2.71 and 2.78 for GS12, Alisa, VT737 and SS33 respectively in case of induce resistance against 1.11, 1.17, 1.18 and 1.24 incase of traditional production method respectively in 2005 season. More improvement was detected for the same rate in 2006 season by using induced resistance proceeding.

Generally the result proved that, using induce resistance method in fall tomato cultivation resulted in increasing total yield and decreasing production cost which lead decreasing the consumer price and increase of net return /Feddan in the same time. Other wise, the using of induce resistance technique will resulted in increasing of both grower return and consumer buying ability.

Conclusion

The results indicated that, applying of induce resistance technique in fall tomato cultivation lead to increasing of Feddan productivity by about 53% and decreasing the production cost by about 39 %, that resulted in improve the growers net return by about 432%, comparing with the traditional cultivation method.

Adopting of the new technique "induced resistance" may increase total fall tomato production by about 590 thousand ton yearly. The increasing of tomato production will lead to increase market supply and then improve the exported amount, especially the new technique also improve the competitive ability of Egyptian tomato by decreasing production cost and pesticides residuals in tomato fruits. Other wise, Adopting of the new technique, may lead to decreasing the cultivated area of fall tomato and replace some oil crops "sesame, sun flower and maize" instead of it in the saved area. That may contribute in solving the oils gaps.

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الكفاءة الإنتاجية والاقتصادية لتطبيق تقنية المقاومة المستحثة فى إنتاج الطماطم النيلية

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استهدف البحث التعرف على الآثار الفنية والاقتصادية لاستخدام أسلوب المقاومة المستحثة فى إنتاج الطماطم النيلية ، وذلك من خلال عينة عشوائية قوامها ٩٦ مفردة بمنطقة الخطاطبة بمحافظة المنوفية وموزعة بالتساوى على الزراع الذين تبنوا أسلوب المقاومة المستحثة والزراع الذين يستخدمون أسلوب المقاومة التقليدية بواقع ٤٨ مزارع بكل منهما وذلك خلال موسمى ٢٠٠٥ ،٢٠٠٦. وقد أشارت النتائج الى أن تطبيق أسلوب المقاومة المستحثة فى إنتاج الطماطم النيلية يؤدى إلى زيادة الإنتاجية الفدانية بحوالى ٥٣% كمتوسط للأصناف الأربعة المدروسة ، وكذلك خفض تكاليف الإنتاج للطن بحوالى ٣٩% ،مما يزيد صافى عائد المزارع بنحو ٤٣٢% وذلك مقارنة بأسلوب المقاومة التقليدية . كما تشير نتائج الدراسة أنه يمكن عن طريق تعميم نتائج الدراسة على المساحة المزروعة بالطماطم النيلية زيادة إنتاج الطماطم بحوالى ٥٩٠ ألف طن سنوياً. وقد تؤدى تلك الزيادة الى زيادة المعروض من الطماطم ومن ثم انخفاض أسعارها من ناحية، وزيادة الصادرات المصرية من الطماطم نظراً لزيادة قدرتها التنافسية فى الأسواق العالمية نتيجة لانخفاض تكلفة الإنتاج وارتفاع جودتها وصلاحيتها للتصدير نظراً لانخفاض الآثار المتبقية للمبيدات بها من ناحية أخرى. كما تشير النتائج إلى أن زيادة إنتاج الطماطم نتيجة تطبيق أسلوب المقاومة المستحثة يمكن أن يساهم فى أحلال بعض المحاصيل الزيتية مثل السمسم وعباد الشمس والذرة محل محصول الطماطم النيلية فى بعض المساحات مما يقلل من حجم الفجوة الزيتية فى مصر وبما لا يؤثر فى المعروض الطماطم. ولذل توصى الدراسة بضرورة تشجيع الزراع على تطبيق أسلوب المقاومة المستحثة فى إنتاج الطماطم النيلية سواء عن طريق الحقول الإرشادية أو البرامج الزراعية المتخصصة فى القنوات التليفزيونية المحلية.