

REDUCTION OF FLOWER DROPPING IN SOME FABA BEAN CULTIVARS BY GROWTH REGULATORS FOLIAR APPLICATION

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ABSTRACT

This study was carried out to determine the response of three faba bean cultivars to growth regulators treatments to reduce faba bean flowers abortion and increase seed production. Two field experiments were carried out at Dakahlia Governorate, Egypt, during 2009/2010 and 2010/2011 seasons. It could be achieved through selecting some promising faba bean (*Vicia faba* L.) cultivars *i.e.* Giza 716, Sakha 1 and Giza 3 and foliar spraying with plant growth regulators treatments *i.e.* control, 50 ppm GA₃, 100 ppm GA₃, 50 ppm IAA and 100 ppm IAA.

Faba bean cultivars significantly differed in averages of plant height, number of branches/plant, number of shedding flower, shedding percentage (%), number of pods/plant, number of seeds/pod, number of seeds/plant, seed yield (g)/plant, 100–seed weight and seed yield (ton/ha). Giza 716 cultivar significantly exceeded other studied cultivars in all studied characters except number of shedding flower and shedding percentage, while, Sakha 1 cultivar produced the lowest averages of these characters.

Spraying plant growth regulator significantly affected plant height (cm), number of branches/plant, number of shedding flower, shedding percentage (%), number of pods/plant, number of seeds/pod, number of seeds/plant, 100–seed weight (g) seed weight of plant, and seed yield (ton/ha). Highest numbers of shedding flowers and shedding percentage % were obtained. Spraying GA₃ or IAA at 100 ppm surpassed the control treatment by 31.6 and 4.10 %, respectively in number of shedding flowers/plant.

This investigation is an attempt to study the role of plant growth regulators for reducing flowers abortion of some faba bean cultivars.

Keywords: GA₃, IAA, Faba bean cultivars, Flowers abortion and shedding percentage

INTRODUCTION

Faba bean is one of the most important legume crops in Egypt as it offers human nutrition with protein. Faba bean shares other legume crops the problem of flowers and young fruit abscission. Many factors are affecting the production of faba bean cultivars such as flowers abortion. Abscission percentage in buds, flowers and immature pods was found to be 92.5 and 89.5 % for Giza 2 and Giza 402 cultivars, respectively (Rabie *et al*, 1991). Faba bean cultivars markedly differed in their growth characteristics and potential yield and yield component *i.e.* number of branches/plant, number of pods and seeds/plant, 100–seed weight, seed yield/plant and seed yield/fed. (El-Shazly and El-Rassas, 1989, Dawwam and Abdel-Aal, 1991, El-Batel and Abd-El-Gawad, 1991, Amer *et al*, 1992 and Hussein *et al*, 1999, Zaki, 1999). Hussein *et al*, 1995 indicated that Giza 716 cultivar produced highest number of pods and seeds/plant and seed yield/plant followed by 123 A/45/67 genotype. Similar conclusion was reported by (Hassanein and Ahmed, 1996, Hassan *et al*, 1997, Ashmawy *et al*, 1998, EL-Zymair, *et al*, 1998) on Giza 3

and Giza 461 varieties. Giza Blanka variety was superior to Giza 716 and Giza 461 varieties in yield and its components reported similar conclusion on Giza 3, Giza 461 and Giza 716 cultivars. Plant height, number of branches/plant, number of pods/plant, number of seeds/pod and seed yield/plant were significantly differed according to cultivars (Abdel-Aziz and Shalaby, 1999, Hassanein, 2000, Metwally *et al*, 2000 , Abou-Taleb, 2002 and Mekky *et al*, 2003). El-Far, 2001 and Bakheit *et al*, 2001 indicated that Giza 674 cultivar had the highest number of branches, number of pods and seed yield, straw yield, Renablanka cultivar gave highest 100-seed weight. Hussein *et al*, 2002 and Khafaga *et al*, 2009 reported that Giza 40 cultivar significantly increased seed yield by 0.43 ton/ha (8.9 %) over that of Misr 1 cultivar. Metwally and Wally, 2003 concluded that the best lines could be arranged as follows: Assiut 4, Assiut 114, Assiut 104 and Assiut 99. Salama and Awaad, 2005 indicated that Giza 714 was the best cultivar for yield and its components. Faba bean cultivars had a significant effect on biological yields (Dahmardeh *et al*, 2010 and Bakry *et al*, 2011).

Application of plant growth regulators is one of the most important ways for reducing flower abscission. It is known to influence growth and development at very low concentrations but inhibit plant growth and development at high concentrations (EL-Abd *et al*, 1989, Amanullah *et al*, 2010). Foliar application of GA₃ on faba bean was found to decrease flower abortion (Khare *et al*, 1993, Shehata and Bondok, 1996, Shalaby and El-Ashry, 2001). Spraying of *Vicia faba* cv. troy with indel-3-acetic or gibberellic acid increased number of branches/plant and number of pods/plant (Clifford *et al*, 1992, Khafaga *et al*, 2009). Similar conclusions were reported by (Aldesuquy and Gaber, 1993 and Ibrahim *et al*, 2007).

Moreover, Hassanein *et al*, 2000 and Zaki, 1999 reported that faba bean cultivars of Giza 461, Giza 3 and Giza Blanka and foliar spraying with GA₃ and IAA significantly differed in growth characters, yield and its components. Khafaga *et al*, 2009 reported that foliar application of faba bean Giza 40 cultivar with paclobutrazol at 200 ppm recorded tallest plants, highest fresh and dry weights/plant, leaf area, number of branches/plant, number of pods/plant, number of seed/pod, 100-seed weight and seed yield.

The objectives of this work was to evaluate the efficiency of foliar application of some promising faba bean cultivars with plant growth for reducing flowers abortion and enhancing seed production.

MATERIALS AND METHODS

Treatments and Experimental Design:

The treatments were arranged in a split-plot design with three replications. The main plots were occupied with the following three faba bean cultivars i.e. Giza 716, Giza 3 and Sakha 1. Studied cultivars were obtained from legume section, Agricultural Research Center, Ministry of Agriculture and Land Reclamations, Egypt. The sub plots were assigned to five treatments of spraying with plant growth regulators i.e. Control, GA₃ 50 ppm, GA₃ 100 ppm, IAA 50 ppm and IAA 100 PPM. All these treatments were applied at flowering stage, after 45 days from planting. Each experimental

sub plot included four ridges, each of 60 cm width and 3.5 m long, resulted an area of 10.5 m² (1/400 fed).

Soil samples were taken at random from the experimental field area at a depth of 15 and 30 cm from soil surface before seed bed preparation during the growing seasons to measure the physical and chemical soil properties. The soil was clay in texture, the pH was 7.7, 7.4; available nitrogen was 1.87 and 1.96 ppm in both seasons, respectively.

Agricultural practices:

The experimental field was well prepared through two ploughing, leveling, and compaction, ridging and then divided into the experimental units (10.5 m²). Calcium superphosphate (15.5 % P₂O₅) was applied during soil preparation at the rate of 100 kg/fed.

Faba bean seeds were soaked in water for 24 hours before planting to raise seed germination. Planting of seeds was carried out on October 20th and 9th in both seasons and on both sides of ridges at 25 cm between hills and 60 cm between ridges. Hand hoeing was achieved every 21 days to control weeds (*i.e.* before time of irrigations). Nitrogen in the form of ammonium nitrate (33.0 % N) at the rate of 15 kg N/fed as starter dose was added before first irrigation, Potassium sulphate (48 % K₂O) was added at the rate of 50 kg/fed to the soil in two equal doses before the first and second irrigations. The common agricultural practices for growing field bean plants according to the recommendations of Ministry of Agriculture were followed, except the factors under this study.

Studied characteristics:

All studied characteristics were applied at harvest time where, ten guarded plants were taken from the outer ridges from each sub plot to estimate the following characters.

1. Plant height (cm): it was measured for each plant of the samples from the soil surface to the top of the plants.
2. Number of branches/plant.
- 3- Number of shedding flowers
- 4-Shedding percentage: it was determined by using the following equation:

$$\text{Shedding \%} = \frac{\text{Shedding}}{\text{Shedding} + \text{number of mature pods}} \times 100$$

At harvest time, marketable pods per plant were picked and let to dry up normal and data were recorded for the following traits:

5. Number of pods/plant.
6. Number of seeds/pod.
7. Number of seeds/plant.
8. Seed yield (g)/plant.
9. 100 – seed weight (g).
- 10- Seed yield (ton/ha): whole plants produced from the three inner ridges of each plot were harvested and let to dry on air, then they were threshed and the seeds (which were at 13 % moisture) were weighted (kg), then converted to (Kg/ha).

Statistical analysis:

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the split – plot design as published by Gomez and Gomez, 1984 by using means of “MSTAT-C”

computer software package. Least Significant Difference (LSD) method was used to test the differences between treatment means at 5 % level of probability as described by Snedecor and Cochran, 1980.

RESULTS AND DISCUSSION

Performance of cultivars:

The three tested cultivars of faba bean significantly differed for plant height (cm), number of branches/plant, number of shedding flowers, shedding percentage %, number of pods/plant, number of seeds/plant, seeds weight/plant, number of seeds/pod, 100 seed weight, weight of seeds/plant as well as seed yield ton/ha (Tables 1 and 2). Giza 716 cultivar significantly surpassed other studied cultivars Giza 3 and Saka1 in all vegetative growth, yield component characters and also seed yield/ha, which recorded highest values of all studied characters in the two seasons. Vice versa, Giza 716 recorded lowest number of shedding flowers and shedding percentage in both seasons. Whereas, Sakha 1 cultivar recorded the last rank in both seasons and recorded highest number of shedding flowers and shedding percentage in both seasons. Giza 3 cultivar produced intermediate values of these characters in both seasons. It is worthy to mention that the differences among all studied cultivars were significant in all vegetative growth, seed yield and its components in both seasons. These findings might be attributed to the differences in their genetically constitution and genetic factors makeup. In general, it could be summarized that Giza 716 cultivar surpassed Sakha 1 cultivar by 13.71 % in number of branches/plant, by 4.29 % in 100-seed weight and by 19.1 % in seed weight/plant as an average of both seasons. Vice versa, Sakha 1 cultivar surpassed Giza 716 cultivar by 10.08 % in number of shedding flowers/plant and by 3.0 % in shedding percentage as an average in both seasons. Moreover, Giza 716 cultivar surpassed Sakha 1 by 11.76 % and Giza 3 by 6.6 %, in number of pods/plant, and by 16.25 % and 7.0 % in number of seed /pod, and by 30.61 % and 14.63 % in number of seeds per plant, and by 11.51 % and 3.68 % in seed yield ton/ha as an average of both seasons, respectively. Similar conclusions were reported by (Abou-Taleb, 2002, Mekky *et al*, 2003), Salama and Awaad, 2005), Dahmardeh *et al*, 2010) and Bakry *et al*, 2011).

Plant growth regulators treatments:

The results in Tables 1 and 2 indicated that plant growth regulators treatments had significant effects on plant height, number of branches/plant, number of shedding flowers, shedding percentages, number of pods/plant, number of seeds/pod, number of seeds/plant, 100 seed weight, weight of seeds/plant as well as seed yield /ha in both seasons. Spraying faba bean plants with GA3 or IAA at 100 ppm significantly exceeded vegetative growth, yield and yield components in both seasons and markedly recorded the highest values of all studied characters, vice versa recorded the lowest numbers of flowers and shedding percentages in both seasons.

Conversely, the lowest values of these characters were obtained from the control treatment, except number of flower and shedding percentage. The desirable effect on shedding percentage as a result of using GA3 as plant growth regulators might be due to the role of GA3 and IAA on minimizing the number of flower abortion. Moreover, Endogenous IAA, gibberellins and cytokinins increased during flowering and at abscission time, however, ABA content was decreased by all applied concentrations of IAA and gibberellins. In addition, the desirable effect on plant height, number of seed/pod, number of pods/plant and seed yield/ha as a result of using GA3 as plant growth regulators might be imputed to development processes such as minimizing the number of shedding flower which reflected maximum number of pods/plant and seed yield/ha (Table 1). Ibrahim *et al*, 2007 reported that application of IAA caused reduction in the flower abscission percentage and then producing highest number of pod setting and weight of seed/pod as well as weight of 100 seeds. In general, it could be stated that spraying faba bean plants with GA3 or IAA at 100 ppm significantly exceeded plant height by 9.43 % and 8.0 %, number of pods/plant by 19.04 and 13.06 %, number of seeds/pod by 31.3 % and 25.81 %, number of seed/plant by 56.65 % and 43.37 %, 100-seed weight (g) by 12.57 and 8.46 %, 45.29 and 35.10 % and seed yield ton/ha by 24.1 and 19.7 % over the control treatment as an average of both seasons, respectively. Similar conclusions were recorded by Khare *et al*, 1993),-Shehata and Bondok, 1996, Hassanein *et al*, 2000 and Amanullah *et al*, 2010).

Interactions effect:

The interaction between faba bean cultivars and foliar application of growth regulator treatments significantly affected plant height, number of pods/plant, number of seeds/pod, number of seed/plant 100-seed weight and seed yield/ha in both season, except number of branches /plant in the second season. Results graphically illustrated (Fig.1, 2 and 3) that highest averages of number of pods/plant, 100seed weight and seed yield/ha were resulted from sowing Giza 716 cultivars and spraying plants with 100 ppm GA3 as plant growth regulators in both seasons. While, the lowest averages of these characters were recorded with sowing Sakha 1 cultivars and without plant growth regulators application in both seasons. In general, sown Giza 716 cultivar and foliar spraying of GA3 at 100 ppm exceeded plant height, number of pods/plant, number of seeds/pod, number of seeds/plant, 100-seed weight, seed yield (ton/ha) by 12.98 %, 23.28 %, 57.0 %, 103.0 %, 19.22 % and 41.8 %, respectively compared with sowing Sakha 1 and without foliar application of plant growth regulators as an averages of both seasons. These results may be due to response of Giza 716 cultivar to GA3 or IAA application which reflected in reducing the flower abscission percentage, increasing in number of branches/plant and then producing highest number of pod setting then increased seed yield. These results are agreement with those recorded by Zaki, 1999, Hassanein *et al*, 2000 and Khafaga *et al*, 2009.

Fig. 1: Averages number of pods/plant as affected by the interaction between cultivars and plant growth regulators treatments during 2009/2010 and 2010/2011 seasons.

Fig. 2: Averages 100-seed weight (g) as affected by the interaction between cultivars and plant growth regulators treatments during 2009/2010 and 2010/2011 seasons.

Fig. 3: Averages seed yield (ton/ha) as affected by the interaction between cultivars and plant growth regulators treatments during 2009/2010 and 2010/2011 seasons.

CONCLUSIONS

It could be concluded that sowing faba bean Giza 716 cultivars and foliar application of GA₃ or IAA at 100 ppm maximized seed yield due to reducing flower shedding percentages and escalating yield components.

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معاملات زيادة العقد وخفض نسبة التساقط في نبات الفول البلدى
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أجريت تجربتان حقليتان خلال الموسمين الزراعيين الشتويين ٢٠٠٩/٢٠١٠ ، ٢٠١٠/٢٠١١ بقرية طوخ الأقلام - مركز السنبلوين - محافظة الدقهلية لدراسة تأثير ثلاثة أصناف من الفول البلدى وهى جيزة ٧١٦، سخا ١ وجيزة ٣ لمعاملات الرش ببعض منظمات النمو وهى كينترول بدون رش، الرش بالجبريلين بتركيز ٥٠ جزء فى المليون، والرش بالجبريلين ١٠٠ جزء فى المليون ، الرش بأندول حمض الخليك بتركيز ٥٠ جزء فى المليون والرش بأندول حمض الخليك بتركيز ١٠٠ جزء فى المليون وكذلك التفاعل بينهم وأثر ذلك على المحصول ومكوناته. تم تنفيذ التجارب فى تصميم القطع المنشفة مرة واحدة فى ثلاث مكررات ، حيث إشتملت القطع الرئيسية على الأصناف الثلاثة بينما احتلت القطع الشقية معاملات الرش بمنظمات النمو المختلفة.

أظهرت النتائج المتحصل عليها إختلاف الأصناف تحت الدراسة إختلافاً معنوياً فى كل من الصفات التالية: طول الساق (سم) ، عدد الفروع / نبات ، عدد الأزهار الساقطة/ نبات ، نسبة التساقط (%) ، عدد القرون / نبات ، عدد البذور / قرن ، عدد البذور / نبات ، وزن ١٠٠ بذرة ، وزن البذور / نبات و محصول البذور بالطن/هكتار فى كلا الموسمين ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١. كما أشارت النتائج تفوق الصنف جيزة ٧١٦ عن بقية الأصناف تحت الدراسة فى جميع صفات النمو الخضرى وكذلك المحصول ومكوناته. كما أوضحت النتائج المتحصل عليها تفوق الصنف جيزة ٧١٦ على الصنف سخا ١ بنسبة ١١,٧٦% وعلى الصنف جيزة ٣ بنسبة ٦,٦% لصفة عدد القرون/نبات ، بنسبة (١٦,٢٧ و ٧,٠%) لصفة عدد البذور / للقرن ، بنسبة (٣٠,٦١ و ١٤,٦٣%) لصفة عدد البذور/نبات و بنسبة (١١,٥١ و ٣,٦٨%) لصفة محصول البذور (طن/هكتار) كمتوسط للموسمين على الترتيب.

أشارت النتائج المتحصل عليها إلى وجود تأثير معنوى بين معاملات الرش بمنظمات النمو على صفات طول الساق (سم) ، عدد الفروع / نبات ، عدد الأزهار الساقطة/ نبات ، نسبة التساقط (%) ، عدد القرون / نبات ، عدد البذور / قرن ، عدد البذور / نبات ، وزن ١٠٠ بذرة ، وزن البذور / نبات و محصول البذور بالطن/هكتار خلال موسمى ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١. أظهرت النتائج أن الرش بالجبريلين أو أندول حامض الخليك بتركيز ١٠٠ جزء فى المليون أدى إلى زيادة معنوية طول النبات (سم) بنسبة (٩,٤٣ و ٨,٠%) ، عدد قرون/نبات بنسبة (١٩,٠٤ و ١٣,٠٦%) ، عدد البذور/قرن بنسبة (٣١,٣٠ و ٢٥,٨١%) ، عدد البذور/نبات بنسبة (٥٦,٦٥ و ٤٣,٣٧%) ، وزن ١٠٠ بذرة جم بنسبة (١٢,٥٧ و ٨,٤٦%) و محصول البذور (طن/هكتار) بنسبة (٢٤,١٠ و ١٩,٧٠%) مقارنة بمعاملة الكنترول (بدون رش) وذلك كمتوسط للموسمين على التوالى . كما أظهرت النتائج المتحصل عليها أن أعلى عدد من الأزهار الساقطة وكذلك أعلى نسبة تساقط للأزهار تم الحصول عليها من معاملة الكنترول (بدون رش) فى كلا الموسمين ، كما أشارت النتائج إلى أن الرش بالجبريلين أو أندول حامض الخليك بتركيز ١٠٠ جزء فى أدى إلى تقليل عدد الأزهار المتساقطة مما أدى إلى تقليل نسبة التساقط.

أظهرت النتائج أن التفاعل بين الأصناف ومعاملات منظمات النمو قد أثرت معنوياً على صفات طول النبات (سم) ، عدد قرون/نبات ، عدد بذور/قرن ، عدد بذور /نبات ، وزن ١٠٠ بذرة (جم) و محصول البذور (طن/هكتار) تأثرت تأثيراً معنوياً بالتفاعل بين الأصناف ومعاملات الرش بمنظمات النمو المختلفة فى كلا الموسمين تحت الدراسة. بينما لم تتأثر صفتى كل من عدد الأزهار المتساقطة ونسبة التساقط ووزن بذور النبات معنوياً بالتفاعل بين الأصناف ومعاملات الرش بمنظمات النمو فى كلا الموسمين. أدى زراعة الصنف جيزة ٧١٦ والرش بالجبريلين أو أندول حمض الخليك بتركيز ١٠٠ جزء فى المليون سجل أعلى القيم لصفات المحصول ومكوناته لنبات الفول البلدى.

قام بتحكيم البحث

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Table 1: Averages plant height, Number of branches/plant, number of shedding flowers, number of shedding flowers, number of shedding flowers and number of pods/plant as affected by cultivars and plant growth regulators treatments during 2009/2010 and 2010/2011 growing seasons.

Characters Treatments	Plant height (cm)		Number of branches/plant		Number of shedding flowers		Shedding percentage (%)		Number of pods/plant	
	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011
Cultivars:										
Giza716	105.66	110.77	5.03	5.00	108.57	119.56	82.67	83.59	23.46	22.26
Giza3	105.19	107.32	4.85	4.56	114.62	127.89	84.08	85.94	22.36	21.28
Sakha1	104.83	106.88	4.78	4.04	116.98	134.18	84.74	86.56	21.00	19.85
F test	*	*	*	**	*	**	**	**	**	**
LSD at 5%	0.60	2.88	0.17	0.24	5.17	3.99	0.59	1.37	0.68	0.67
LSD at 1%	-	-	-	0.39	-	6.62	0.98	2.28	1.13	1.12
Plant growth regulators treatments:										
Control	100.67	102.81	4.05	3.84	132.68	152.17	87.79	88.99	20.68	19.24
GA ₃ 50 ppm	103.76	108.04	4.75	4.53	109.95	123.61	83.82	85.35	21.84	20.73
GA ₃ 100 ppm	109.25	113.54	5.48	5.07	104.61	111.71	81.39	82.20	24.24	23.14
IAA 50 ppm	105.43	106.41	4.87	4.54	111.91	131.17	83.91	86.53	21.55	20.45
IAA 100 ppm	107.01	111.16	5.27	4.70	107.80	117.38	82.23	83.76	23.05	22.07
F test	**	**	**	**	**	**	**	**	**	**
LSD at 5%	0.87	1.02	0.21	0.12	4.39	6.69	0.63	0.59	0.49	0.45
LSD at 1%	1.18	1.39	0.28	0.12	5.96	9.06	0.85	0.80	0.66	0.61

Table 2: Averages number of seeds/pod, number of seeds/plant, 100-seed weight (g), weight of seeds/plant and seed yield (ton/Ha) as affected by cultivars and plant growth regulators treatments during 2009/2010 and 2010/2011 growing seasons.

Characters Treatments	Number of seeds/pod		Number of seeds/plant		100-seed weight (g)		Weight of seeds/plant		Seed yield (ton/Ha)	
	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011
Cultivars:										
Giza716	3.67	4.77	86.88	107.03	94.93	95.76	76.84	71.75	4.044	3.925
Giza3	3.39	4.38	76.41	93.77	91.53	93.08	69.57	61.15	3.758	3.651
Sakha1	3.22	4.04	67.88	80.58	90.80	92.04	65.06	59.70	3.610	3.536
F test	**	**	**	**	**	**	**	*	**	**
LSD at 5%	0.09	0.18	2.73	4.46	1.30	0.79	3.77	6.41	0.04	0.04
LSD at 1%	0.14	0.25	4.52	7.40	2.16	1.30	6.26	-	0.06	0.07
Plant growth regulators treatments:										
Control	2.91	3.83	60.26	73.91	86.88	87.40	54.51	53.77	3.385	3.272
GA ₃ 50 ppm	3.42	4.34	74.91	90.30	92.55	94.23	69.84	63.35	3.740	3.598
GA ₃ 100 ppm	3.91	4.94	95.21	114.97	97.44	98.75	82.57	74.76	4.177	4.085
IAA 50 ppm	3.21	4.07	69.26	83.71	91.33	92.61	68.52	59.82	3.692	3.619
IAA 100 ppm	3.70	4.78	85.66	106.07	93.88	95.16	77.01	69.28	4.025	3.945
F test	**	**	**	**	**	**	**	**	**	**
LSD at 5%	0.16	0.12	3.77	3.74	1.62	1.65	3.98	3.66	0.06	0.07
LSD at 1%	0.22	0.16	5.12	5.07	2.20	2.24	5.40	4.96	0.08	0.09

