4. RESULTS AND DISCUSSION

4.1. Vegetative growth:

4.1.1. Shoot length (cm):

Data tabulated in Table (2) show the effect of spraying paclobutrazol (PP_{333}) and uniconazole (S-3307D) at different rate and date on shoot length of "Anna" apple trees during 1996 and 1997 season.

From data of 1996 season, it could be noticed that no significant differences were noticed between different treatments in their shoot length due to good choice of tested shoot in the begining of working. It is clear that spraying of S-3307D and PP_{333} at Mid-May was effective than spraying at full bloom due to its great effect on flower bud induction and consequently affect the following yield. Spraying of PP_{333} and S-3307D at 1000 or 2000 ppm in May hastened the growth of shoots than other treatment. The effect of PP_{333} and uni. was very clear in the second season due to its cummulative effect.

However, the treatment of S-3307D 1000 ppm sprayed at Mid-May was effective than others in increasing shoot length, whereas the least effects were obtained by PP_{333} 2000 ppm or S-3307D 2000 ppm sprayed at full bloom. Regarding to the increasing rate, it could be noticed that the same trend of results were also found. Generally, it could be noticed that all treatments done at full bloom were produced short shoots than control. Data of the second season declare an opposite trend where all treatments sprayed at full bloom or Mid-May produced short shoots compared to control. However, no significant differences between the treatment of PP_{333} 2000 ppm in Mid-May or control. Generally, it could be noticed that the rate of shoot length growth were less in second season than in the first one. The obtained

Table (2): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on average shoot length of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	1996 Season					1997 Season				
	Starting date		Ending date		% of increase	Starting date		Ending date		% of increase
Control	1.126	A	19.36	C	1618.932	1.167	A	17.867	A	1431.019
PP_{333} 1000 F.B.	1.140	A	9.833	E	762.543	1.133	A	6.800	F	500.176
PP_{333} 2000 F.B.	1.133	A	8.233	F	519.022	1.360	A	8.900	E	554.411
S-3307D 1000 F.B.	1.160	A	11.700	D	908.621	1.413	A	11.033	D	680.821
S-3307D 2000 F.B.	1.213	A	7.966	F	556.598	1.174	A	6.633	F	478.291
S-3307D 1000 F.B. + PP_{333} 1000 M.May	1.133	A	9.566	E	744.369	1.173	A	8.200	E	599.062
S-3307D 2000 F.B. + PP_{333} 1000 M.May	1.166	A	8.233	F	605.684	1.233	A	5.710	F	363.098
PP_{333} 1000 M.May	1.166	A	21.166	B	1714.283	1.147	A	14.767	C	1187.445
PP_{333} 2000 M.May	1.200	A	20.166	C	1580.558	1.227	A	16.800	AB	1269.193
S-3307D1000 M.May	1.186	A	23.466	A	1877.525	1.560	A	15.633	BC	902.1154
S-3307D2000 M.May	1.206	A	21.133	B	1651.349	1.200	A	14.500	C	1108.333

* Starting date was at full bloom (some treatments) and Mid-May (others) Ending date at 15 September of both seasons.

Means have the same letter(s) in a column are not differ significantly at a 5% level.

results dealing with PP_{333} application with those findings by **Zhu *et al.*, (1996)** on walnuts; **Khurshid *et al.*, (1997)** on apple and **George *et al.*, (1997)** on peach. Additionally, **Curry** and **Jones (1991)** and Forlanij and **Coppola (1993)** obtained similar results on uniconazole.

On the contrary, **Maltoni (1990)** mentioned that Cherry growth was increased with the paclobutrazol treatment at the second year of treatment.

4.1.2. Average leaf number:

It is clear from tabulated data in Table (3) that average leaves numbers were greatly affected with using paclobutrazol PP_{333} and uniconazole (S-3307D) spraying on 'Anna' apple trees during 1996 and 1997 seasons.

It is usually that no significant differences between different treatments in begining of experiment. It is clear from first season data that the highest number of leaves were obtained with spraying PP_{333} at 2000 ppm at full bloom, whereas the least number of leaves were recorded by PP_{333} at 2000 ppm but sprayed in Mid-May. The rate of increase in leaves numbers were similar to those obtained in the end of growing season. In the second season, the treatment of S-3307D 2000ppm sprayed at full bloom was superior than others in leaves numbers. All sprayed materials in Mid-May were similar to control with no significant differences between them.

The rate of increase in leaves numbers in second season was similar to data obtained in the growing season ending. Generally, it could be noticed that using PP_{333} and S-3307D as growth retardant

Table (3): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on average leaf number of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	1996 Season					1997 Season				
	Starting date		Ending date		% of increase	Starting date		Ending date		% of increase
Control	4.00	A	11.40	D	185	4.067	A	12.00	E	195.058
PP_{333} 1000 F.B.	4.00	A	15.200	B	280	3.933	A	15.60	ABC	296.644
PP_{333} 2000 F.B.	4.80	A	16.800	A	250	4.533	A	16.433	AB	262.519
S-3307D 1000 F.B.	4.87	A	13.97	C	186.985	4.133	A	15.167	BC	266.973
S-3307D 2000 F.B.	4.00	A	14.400	C	260	3.800	A	17.167	A	357.763
S-3307D 1000 F.B. + PP_{333} 1000 M.May	4.20	A	14.250	C	239.286	4.333	A	12.250	DE	182.714
S-3307D 2000 F.B. + PP_{333} 1000 M.May	4.40	A	15.300	B	247.727	4.400	A	13.967	CD	217.432
PP_{333} 1000 M.May	4.33	A	11.367	ED	162.329	4.267	A	11.133	E	160.909
PP_{333} 2000 M.May	4.33	A	10.900	E	151.558	4.600	A	11.900	E	158.696
S-3307D1000 M.May	4.533	A	11.433	D	152.217	4.333	A	12.100	E	179.252
S-3307D2000 M.May	4.533	A	11.20	ED	158.481	4.333	A	12.000	E	176.944

* Starting date was at full bloom (some treatments) and Mid-May (others) Ending date at 15 September of both seasons.

Means have the same letter(s) in a column are not differ significantly at a 5% level.

materials slightly affected leaves number in the spraying season but probably affected it in following season.

The obtained results are in contrast with those found by **Hao *et al.*, (1994)** on apple who mentioned that paclobutrazol did not affect leaf number.

4.2. Flowering: Flowering % (on spurs and on one year old shoot), number of flowers in spurs and time of flowering in the second season.

Data presented in Table (4) show the effect of paclobutrazol (PP_{333}) and uniconazole (S-3307D) materials sprayed at different dates and rates on flowering % on spurs and one year old shoots of 'Anna' apples during 1997 season. Data (the following season of spraying) of first season showed that both PP_{333} and S-3307D materials were slightly affected flowering % of 'Anna' apples. No significant differences were detected between the treatments of PP_{333} and S-3307D sprayed at full bloom or in Mid-May either alone or in combination together. However, the highest values of flowering % on spur were obtained with S-3307D 1000ppm at full bloom + PP_{333} 1000 ppm at Mid-May and S-3307D 2000 ppm in Mid-May.

Regarding to flowering % on one year old shoot, it is clear that the same trend obtained in flowering % on spur. Data declare also that flowering % was generally higher on spur than on one year old shoot in 'Anna' apples. Such findings are in accordance with the previous results obtained by **Mei *et al.*, (1995)** on pear, **Wang *et al.*, & Szewczuk (1995)** on peach who mentioned that PP_{333} increased flower bud formation. Also, **Forlani *et al.*, (1991).** On nectarine who found

Table (4): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on % of flowering on spurs and shoots, mean number of flowers per inflorescence and time of flowering of "Anna" apple trees during 1997 seasons (one season only).

Treatments	1997 Season						
	% of flowering spurs		% of flowering on shoots		Number of flowering inflorescence		Time of flowering
Control	87.00	A	29.00	A	5.33	A	11-4-97
PP_{333} 1000 F.B.	83.00	AB	27.73	AB	5.33	A	8-4-97
PP_{333} 2000 F.B.	87.33	A	29.10	A	5.33	A	8-4-97
S-3307D 1000 F.B.	86.00	AB	28.67	AB	5.33	A	9-4-97
S-3307D 2000 F.B.	85.00	AB	28.30	AB	5.33	A	9-4-97
S-3307D 1000 F.B. + PP_{333} 1000 M.May	83.67	AB	27.87	AB	5.33	A	6-4-97
S-3307D 2000 F.B. + PP_{333} 1000 M.May	85.33	AB	28.40	AB	5.33	A	6-4-97
PP_{333} 1000 M.May	82.67	AB	27.53	AB	5.33	A	5-4-97
PP_{333} 2000 M.May	82.67	AB	27.27	AB	5.33	A	6-4-97
S-3307D1000 M.May	79.67	AB	26.50	B	5.33	A	6-4-97
S-3307D2000 M.May	82.67	AB	27.53	AB	5.33	A	6-4-97

Means have the same letter(s) in a column are not differ significantly at a 5% level.

that S-3307D improved bud differentiation on contrary, **Khurshid *et al.*, (1997)** stated that total bud number was consistently reduced with PBZ application.

It is clear that time of flowering in the following season of spraying growth retardation (1997) greatly affected. Control trees flowered in 11-4-1997 whereas treatments flowered early by 2-6 days depends on the used treatments. Generally it could be mentioned that Mid-May application were more effective than those applied at ful bloom and these may be due to their great effect on flower bud differentiation hapend in Mid- May, June. **Shandler (1942)** The obtained results are in line with the findings of **Lurie *et al.*, (1997)** on plum who said hat treated trees flowered earlier the following year than untreated control trees.

No effect to both PP_{333} and S-3307D sprayed at different dates and rates of the number of flowers in inflorescence of 'Anna' apples where it was 5.33 flower/inflorescence. The above results are generally in line with those of **Wanishkul & Lenz (1990)** on apple who revealed that PB has little effect on flower formation.

4.3. Fruit set and fruit abscission %:

Data tabulated in Table (5) show fruit set % and fruit abscission % either on spurs or on one-year old shoot of 'Anna' apples as affected by spraying paclobutrazol (PP_{333}) and uniconazole (S-3307D) during 1996 and 1997 seasons.

It is clear generally that fruit set and fruit abscission % were higher on spurs than on one year old shoot and this phenomen is characterized in 'Anna' apples. On the other hand, the treatment of

Table (5): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on % of fruit set and abscission on spurs and shoots of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	1996 Season				1997 Season			
	% Of fruit set on spurs	% Of fruit set on shoots	% Of abscission on spurs	% Of abscission on shoots	% Of fruit set on spurs	% Of fruit set on shoots	% Of abscission on spurs	% Of abscission on shoots
Control	69.67 E	33.67 F	40.33 E	23.67 G	53.33 H	42.33 E	36.00 H	17.00 D
PP_{333} 1000 F.B.	84.00 B	44.00 C	62.67 AB	50.00 AB	78.67 CDE	70.67 B	63.67 C	28.00 C
PP_{333} 2000 F.B.	85.00 AB	47.00 B	61.33 C	39.33 E	81.00 BCD	77.33 A	68.33 B	28.00 C
S-3307D 1000 F.B.	79.00 D	50.00 A	63.67 A	52.67 A	82.00 BC	70.00 B	60.67 DE	51.33 A
S-3307D 2000 F.B.	86.33 A	43.67 C	61.00 BC	47.00 C	90.67 A	68.33 B	76.00 A	38.67 B
S-3307D 1000 F.B. + PP_{333} 1000 M.May	84.33 B	42.00 D	59.00 C	43.67 D	82.67 B	65.67 B	59.00 E	48.00 A
S-3307D 2000 F.B. + PP_{333} 1000 M.May	82.00 C	38.00 E	62.67 AB	49.33 BC	77.67 DEF	58.67 C	61.67 CD	51.00 A
PP_{333} 1000 M.May	66.67 F	33.67 F	45.33 D	27.67 F	68.67 G	45.00 E	46.33 F	35.67 B
PP_{333} 2000 M.May	63.67 G	29.67 G	45.33 D	23.33 G	75.00 F	54.00 CD	44.67 GH	37.00 B
S-3307D1000 M.May	70.67 E	27.33 H	40.67 E	24.67 G	70.00 G	51.67 D	43.33 G	37.67 B
S-3307D2000 M.May	69.67 E	27.33 H	43.33 D	37.00 E	77.00 EF	51.00 D	46.33 F	46.33 A

Means have the same letter(s) in a column are not differ significantly at a 5% level.

2000 ppm S-3307D sprayed at full bloom was sperior than other treatments in fruit set % in both studied seasons. However, the highest fruit set % on one year old shoots were obtained with 1000 ppm S-3307D sprayed at full bloom (first season) and PP_{333} 2000 ppm sprayed at full bloom (second season). In this respect, it could be generally noticed that S-3307D was more effective than PP_{333} in hastering fruit set %. The late application of these materials (PP_{333} or S-3307D) at Mid-May had little or no significant effects such as spraying at full bloom.

The obtained results are in harmony with those found by Chandel & **Jindal (1994)** on plum and **Hao *et al.*, (1994)** on apple who found that spraying PP_{333} (paclobutrazol) increased fruit set. On contrary, **Costa *et al.*, (1995)** on pear showed that application of paclobutrazol alone at full bloom resulted in a great reduction of fruit set.

The higher percentage of fruit abscission on spurs than one year old shoot due to the higher amounts of flower on spurs than on one year old shoots. Such findings are in accordance with the previous results obtained by **Li *et al.*, (1991)** on peach and **Kolodiejcak & Tyhoszuk (1993)** on plum who found that foliar application of cultar increased fruit let drop. On contrary, **Blanco (1990)** on nectarine and **Elfving *et al.*, (1991)** on apple demonstrated that paclobutrazol application reduced preharvest drop.

4.4. Yield attributes:

Data tabulated in Tables (6, 7) show the effect of paclobutrazol (PP_{333}) and uniconazole (S-3307D) spraying on total yield/tree,

number of fruits/spur, total fruits/tree and average fruit weitht of 'Anna' apples during 1996 and 1997 seasons.

It is clear from first season data that there were a great effect to PP_{333} 1000 ppm treatment spraying at full bloom on total yield compared to other treatments or control. However, S-3307D at 2000 ppm spraying at full bloom, PP_{333} 2000 ppm or S-3307D 1000 ppm at full bloom were also effective in increasing total yield but with less effect. No significant differences were noticed between PP_{333} or S-3307D both sprayed at Mid-May and untreated trees. The obtained results are in agreement with those reported by **George *et al.*, (1997)** on peach revealed that yield was increased by PP_{333}. Additionally, **Forlani & Coppola (1993)** on grape obtained the same results. On contrary, **Khursheid *et al.*, (1997)** on apple said that fruit yield was decreased by PP_{333} application. On the other hand, **Holubowicz & Musielak (1993)** on apple found that PP_{333} had no marked effects on yield.

Regarding to the number of fruits/spur data that no significant differences were noticed between control and those trees sprayed completely at Mid-May. However, the trees sprayed at full bloom exhibited some effect in fruit numbers/spur than control. These findings were also noticed in the second season. Total fruits/tree data showed that no clear relationship between yield and total fruit numbers/tree and this attributed to the variance of fruit weight. The highest numbers of fruits/tree were obtained with the trees sprayed with PP_{333} 2000 ppm at full bloom. The results obtained here are in line with these found by **Bist (1991)** on pear indicated that PP_{333} increased

Table (6): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on total yield/kg, Number of fruits/tree and mean fruit weight of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	1996 Season						1997 Season					
	Total yield kg/tree		**Number fruits /tree**		**Mean fruit weight**		**Total yield kg/tree**		**Number fruits /tree**		**Mean fruit weight**	
Control	15.03	DE	118.33	AB	127.00	E	18.59	CD	125.00	F	148.70	A
PP_{333} 1000 F.B.	20.11	A	166.67	B	120.67	C	19.04	BC	183.33	B	103.87	C
PP_{333} 2000 F.B.	18.23	B	203.33	F	89.67	A	20.08	BC	210.00	A	95.63	CD
S-3307D 1000 F.B.	17.33	BC	166.67	B	104.00	E	15.93	E	176.67	BC	90.167	D
S-3307D 2000 F.B.	20.13	A	196.67	A	102.33	E	22.81	A	220.00	A	103.70	C
S-3307D 1000 F.B. + PP_{333} 1000 M.May	16.05	CD	140.00	CD	114.67	D	15.60	E	161.67	D	96.483	CD
S-3307D 2000 F.B. + PP_{333} 1000 M.May	16.86	BCD	146.67	C	115.00	D	16.35	DE	166.67	CD	98.083	CD
PP_{333} 1000 M.May	15.00	DE	120.00	E	125.00	B	18.51	CD	143.33	E	129.33	B
PP_{333} 2000 M.May	14.90	E	115.00	E	128.67	A	18.91	BCD	138.33	E	136.67	AB
S-3307D1000 M.May	15.49	DE	131.67	D	117.67	CD	20.27	B	145.00	E	139.77	AB
S-3307D2000 M.May	15.52	DE	120.00	E	129.33	A	20.15	B	146.67	E	137.37	AB

Means have the same letter(s) in a column are not differ significantly at a 5% level.

Table (7): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on number of fruits/spur and Biennial bearing of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	Number of fruits/spur				Biennial bearing	
	1996 season		1997 season			
Control	1.33	B	1.33	B	10.58	B
PP_{333} 1000 F.B.	2.33	A	2.33	A	2.73	D
PP_{333} 2000 F.B.	2.33	A	2.33	A	4.8	C
S-3307D 1000 F.B.	2.33	A	2.33	A	4.2	CD
S-3307D 2000 F.B.	2.33	A	2.33	A	6.27	C
S-3307D 1000 F.B. + PP_{333} 1000 M.May	2.33	A	2.33	A	1.42	E
S-3307D 2000 F.B. + PP_{333} 1000 M.May	2.33	A	2.33	A	1.57	DE
PP_{333} 1000 M.May	1.33	B	1.33	B	10.5	B
PP_{333} 2000 M.May	1.33	B	1.33	B	12.19	AB
S-3307D1000 M.May	1.33	B	1.33	B	13.36	A
S-3307D2000 M.May	1.33	B	1.33	B	12.9	AB

Means have the same letter(s) in a column are not differ significantly at a 5% level.

the number of fruits/tree. On contrary, **Khurshid *et al.*, (1997)** on apple said that total fruit number per tree was decreased with PP_{333} application.

It is clear that there was clear effect to PP_{333} and S-3307D on biennial bearing. Where control trees recorded 10.58 value of biennial bearing whereas, it reached to 6.57 with S-3307D sprayed in Mid-May. highly significant effect was noticed between untreated or 1000 ppm PP_{333} at full bloom in biennal bearing index. Additionally, the highest values of biennial bearing index were obtained with Mid-May spraying with 1000 or 2000 ppm PP_{333} or 1000 ppm S-3307D. Generally, it could be noticed that 'Anna' apple is characterized by low biennial bearing during successive seasons. Uniconazole (S-3307D) at 1000 or 2000 ppm sprayed at full bloom were similar in their effects on biennial bearing index. Such findings are in accordance with the previous results obtained by **Steffens *et al.*, (1994)** on apple found that yield efficiency index was reduced.

4.5. Fruit quality:

4.5.1. (physical properties):

Data tabulated in Tables (6, 8, 9) show the effect of using two growth retardants materials (paclobutrazol (PP_{333}) and uniconazole (S-3307D) on physical properties of 'Anna' apples during 1996 and 1997 seasons.

Average was differed between different treatments and the highest fruit weight was obtained with PP_{333} and S-3307D 2000 ppm sprayed at Mid-May. On the other hand, all treatments in the second season produced fruits with less weight than control and this was due to the highest % of fruit set than first season. The same findings of results were also found in the second season. These results dealing

Table (8): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on fruits length, width and length/width (shape) of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	1996 Season						1997 Season					
	Length		**Width**		**Length/width**		**Length**		**Width**		**Length/width**	
Control	6.66	ABC	6.46	B	1.03	A	7.40	A	7.17	A	1.03	ABC
PP_{333} 1000 F.B.	5.73	EF	6.23	CD	0.91	D	6.17	CD	5.8	D	1.06	AB
PP_{333} 2000 F.B.	5.81	E	5.68	F	1.02	A	5.77	D	5.83	D	0.99	BC
S-3307D 1000 F.B.	5.82	E	6.01	E	0.97	CB	5.30	E	5.90	D	0.89	D
S-3307D 2000 F.B.	5.51	F	6.17	D	0.89	D	5.83	D	5.77	D	1.01	BC
S-3307D 1000 F.B. + PP_{333} 1000 M.May	6.25	D	6.13	ED	1.09	AB	5.82	D	5.87	D	0.99	BC
S-3307D 2000 F.B. + PP_{333} 1000 M.May	6.27	D	6.12	ED	1.03	A	6.33	C	6.15	CD	1.00	BC
PP_{333} 1000 M.May	6.59	BC	6.33	BC	1.04	A	6.93	B	6.52	BC	1.06	AB
PP_{333} 2000 M.May	6.85	A	6.71	A	1.02	A	6.28	C	6.43	BC	0.97	CD
S-3307D1000 M.May	6.69	AB	6.42	B	1.04	A	7.00	AB	6.37	BC	1.09	A
S-3307D2000 M.May	6.44	CD	6.79	A	0.95	CD	6.77	B	6.73	B	1.00	BC

Means have the same letter(s) in a column are not differ significantly at a 5% level.

Table (9): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on fruit size, firmness (Lb/cm^2), (colour chart) and seeds No. of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	1996 Season				1997 Season			
	Fruit size	Fruit firmness $Lb/inch^2$	Seeds No.	Colour	Fruit size	Fruit firmness $Lb/inch^2$	Seeds No.	Colour
Control	130.00 A	10.97 BCD	4.33 ABC	34 B	166.67 A	11.30 A	4.33 BC	34 A
PP_{333} 1000 F.B.	108.33 C	10.97 BCD	5.67 A	34 B	111.67 EF	10.93 BC	3.67 BC	34 A
PP_{333} 2000 F.B.	96.00 D	10.73 D	3.67 C	34 B	113.33 EF	11.33 A	4.67 AB	35 B
S-3307D 1000 F.B.	118.00 B	11.38 AB	3.67 C	34 B	103.33 F	11.10 AB	4.00 BC	35 B
S-3307D 2000 F.B.	111.67 C	10.90 CD	3.33 C	34 B	115.00 EF	10.70 CD	4.67 AB	35 B
S-3307D 1000 F.B. + PP_{333} 1000 M.May	98.33 D	10.73 D	3.33 C	34 A	105.67 F	11.00 ABC	1.67 D	34 B
S-3307D 2000 F.B. + PP_{333} 1000 M.May	95.00 D	10.63 D	4.00 BC	34 B	125.00 DE	10.97 BC	2.67 CD	35 B
PP_{333} 1000 M.May	121.67 B	10.97 BCD	5.33 AB	34 B	139.00 CD	10.60 D	4.33 BC	35 AB
PP_{333} 2000 M.May	135.00 A	11.17 ABC	3.67 C	34 B	151.67 ABC	10.73 CD	6.33 A	34 B
S-3307D1000 M.May	130.00 A	11.10 ABC	4.33 ABC	34 B	161.67 AB	10.97 BC	5.33 AB	34 A
S-3307D2000 M.May	130.00 A	11.33 A	4.33 ABC	34 B	150.00 BC	11.20 AB	4.00 BC	35 A

Means have the same letter(s) in a column are not differ significantly at a 5% level.

with PP_{333} application are generally in line with those of **Mei *et al.*, (1995)** on pear and Lipecki % **Wieniarska (1996)** on apple who mentioned that fruit weight was reduced. Additionally, **Carry & Jones (1990)** on apple obtained the same results with uniconazole. On contrary, **Lurie *et al.*, (1997)** on plum found that PP_{333} and S-3307D treatments increased fruit weight.

Slightly differenes were noticed between different treatments and control in their fruit size alghouth no treatment, except 2000 ppm PP_{333} sprayed at Mid-May, was superior than control. However, no treatment was superior than control in second season. The above results are similar to those found by **Basak *et al.*, (1995)** on plum who revealed that PP_{333} reduced fruit size. Also, Led **Better & Shonnarard (1994)** found the same with uniconazole. On contrary, **Lurie *et al.*, (1997)** on plum mentioned that PP_{333} and S-3307D increased fruit size.

Regarding to fruit length and width, it is clear that growth retardants application spraying on 'Anna' apples reduced both fruit length and width resulting in small fruits than control. However, slight negative effect on fruit length and width was obtained with PP_{333} 2000 ppm sprayed in Mid-May. On contrary, all treatments reduced fruit length than in second season. The obtained data are in line with those found **by Costa *et al.*, (1995)** on pear who showed that PP_{333} reduced fruits diameter and length. On contrary, **Huang *et al.*, (1993)** on sundry crops treated with PP_{333} improved length and width.

Regarding to fruit shape, it is evident that 'Anna' apples tended to oblonge shape but in these treatments slight increase in L/W (length : width) was foung in the treatment of S-3307D 1000 ppm in Mid-May. The above data are generally in line with those of **El-Khoreiby *et al.*,**

(1990) on apple who found that a linear increase in length : diameter ratio by using PP_{333}. On contrary, **Steffens *et al.*, (1994)** on apple mentioned that fruit length : width ratio was lower from trees receiving PP_{333}. Additionally, **Curry & Jones (1991)** on apple found that foliar applications of uniconazole obtained the same results.

The number of seeds in 'Anna' apples ranged from 3-5 seeds (control) but using growth retardants in Mid-May (S-3307D or PP_{333}) increased the development of seeds and reached to 5.667 for PP_{333} 1000 ppm at full bloom and 6.3 for PP_{333} 2000 ppm at Mid-May for first and second season respectively. The increase of numbers of seeds in "Anna" apples as a result of using growth retardants could be explained that GA_3 caused parthenocarpic fruits so, growth retardants which considered anti Gibberellins expected to increase seed numbers. The obtained data are in harmony with those found by **Huang *et al.*, (1993)** on sundry crops was stated that PP_{333} improved the quality of fruits. On contrary, **Wang *et al.*, (1995)** on peach revealed that fruit quality was unaffected by PP_{333}.

Also, Led **Better & Shonnard (1994)** on grape revealed that spraying S-3307D reduced sinking seeds frequency.

No clear effect to those growth retardants on fruit colouration of 'Anna' apples during 1996 season where all treatments produced fruits with similar colour to untreated trees. However, the treatments of 1000 ppm S-3307D at full bloom followed by 1000 ppm PP_{333} at Mid-May produced fruits with good colour than other treatments on control. On the other hand, in the second (1997) the treatments of PP_{333} 1000 ppm at full bloom and S-3307D 1000 or 2000 ppm in Mid-May produced fruits with similar colour to control trees. Except of these treatments, other treatments hastened fruit colouration. Good fruit colouration of

PP_{333} and S-3307D may be due to their effect on producing small fruits with good colouration than bigger fruits. The obtained results are in agreement with those reported by **Ben & Poniedzialek (1995)** on apple with PP_{333} and **Kim (1994)** on grape with S-3307D who mentioned that colouring was stimulated and increased.

Slightly effect to the used growth retardants (PP_{333} and S-3307D) on fruit firmness was noticed except the treatment of S-3307D 1000 ppm at full bloom and S-3307D 2000 ppm at Mid-May. The positive effect to growth retardants materials on fruit firmness is mainly due to their effect on cell enlargement which produce smaller and firmer fruits. The above results are generally in line with those of **Chandel** and **Jindal (1994)** on plum and **Ben** and **Poniedzialek (1995)** on apple who applied paclobutrazol and mentioned that small fruit generally had firmer flesh than large fruits. On contrary, **Elfving *et al.*, (1991)** on apple found that paclobutrazol applications were less consistent in their effects. On the other hand, **Kara** and **Kaska (1994)** on apple found that foliar sprays of PP_{333} (25% a.i.) has no significant effect on flesh firmness.

4.5.2. T.S.S, acidity and total sugars:

Data tabulated in Table (10) show the effect of spraying paclobutrazol (PP_{333}) and uniconazole (S-3307D) on T.S.S., acidity and total sugars of 'Anna' apples during 1996 and 1997 seasons.

T.S.S. was ranged from 11.86 to 12.76 % regardless of the treatments and the effect of these materials were negligeable on T.S.S. However, PP_{333} at 2000 ppm sprayed at full bloom produced fruits with least amounts of total soluble solids than other treatments. The obtained results are in harmony with those found by **Wang *et al.*, (1995)** on apple who reported that soluble solids content were not

Table (10): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on total soluble solids, acidity and total sugars g/10g dry matter of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	1996 Season						1997 Season					
	Total soluble solids		Acidity		Total sugars		Total soluble solids		Acidity		Total sugars	
Control	12.33	BC	0.48	A	47.31	E	12.00	B	0.43	A-D	48.71	B
PP_{333} 1000 F.B.	12.70	A	0.42	C	56.79	A	12.57	A	0.37	E	54.86	A
PP_{333} 2000 F.B.	11.87	D	0.38	DF	54.792	ABC	12.07	B	0.44	A-C	55.83	A
S-3307D 1000 F.B.	12.50	AB	0.41	CD	55.35	ABC	12.33	AB	0.48	A	54.87	A
S-3307D 2000 F.B.	12.43	ABC	0.41	CD	53.19	C	12.27	AB	0.46	A	53.36	A
S-3307D 1000 F.B. + PP_{333} 1000 M.May	12.77	A	0.46	AB	54.32	BC	12.23	AB	0.44	A-C	54.47	A
S-3307D 2000 F.B. + PP_{333} 1000 M.May	12.77	A	0.37	E	55.79	AB	12.03	B	0.45	AB	55.34	A
PP_{333} 1000 M.May	12.60	AB	0.49	A	49.78	D	12.13	AB	0.38	C-E	48.78	B
PP_{333} 2000 M.May	12.13	CD	0.44	BC	49.11	DE	12.07	B	0.39	B-E	48.07	B
S-3307D1000 M.May	12.47	ABC	0.46	AB	48.18	DE	12.47	AB	0.44	A-C	48.61	B
S-3307D2000 M.May	12.53	AB	0.44	BC	49.99	D	12.10	AB	0.37	D-E	48.34	B

Means have the same letter(s) in a column are not differ significantly at a 5% level.AB

affected by paclobutrazol and **Kim (1992)** on grape who mentioned that the time taken to reach fruit maturity (T.S.S. > 13%) was unaffected by the growth inhibitor uniconazole. On contrary, **Kara & Kaska (1994)** on peach by applying PP_{333} and **Kim (1994)** on grape by using uniconazole increased fruit soluble solids contents. Moreover, **Elfving *et al.*, (1991)** reported that fruit soluble solids content of McIntosh apples was reduced by paclobutrazol and uniconazole.

Total acidity of 'Anna' fruits was unaffected with PP_{333} or S-3307D except of some cases, i.e. S-3307D 2000 ppm at full bloom followed by 1000 ppm at Mid-May produced the least amounts of fruit acidity. The obtained results are in line with the findings of **Rizzolo *et al.*, (1995)** on apple and **Wang *et al.*, (1995)** on peach reported that acidity was not affected by paclobutrazol treatments. On contrary, **Huang *et al.*, (1993)** on sundry crops stated that PP_{333} improved the quality of fruits. However, **Zoiklen *et al.*, (1994)** on grape stated that treatment with PBZ reduced titratable acidity.

Total sugars greatly affected than other chemical components especially to those treatments sprayed only at Mid-May which reduced total sugars than those sprayed at full bloom. PP_{333} at 1000 ppm sprayed at full bloom produced 'Anna' fruits with highest total sugars (56.79% in first season). The present results are in harmony with the findings of **Zhang (1993)** on peach and **Chandel & Jindal (1994)** on plum mentioned that application of paclobutrazol increased fruit sugar content. On contrary, **Forlani & Coppolla (1993)** on grape stated that PP_{333} and S-3307D had a negative effect on fruit sugar concentration. However, **Wang *et al.*, (1995)** on peach revealed that fruit quality was unaffected.

4.6. Leaf Minerral contents:

Data of Tables (11 and 12) show the effect of paclobutrazol (PP_{333}) and uniconazole (S-3307D) on leaf mineral contents of 'Anna' apples during 1996 and 1997 seasons.

It could be noticed that leaf nitrogen content was clearly affected with using these growth retardants. Where a reduction in leaf nitrogen content was noticed in PP_{333} 1000 or 2000 ppm sprayed at full bloom and S-3307D 1000 ppm at full bloom + PP_{333} 1000 ppm at Mid-May. It is noticed that, leaf N content of 'Anna' apples was within the optimum level in apple leaves (2.0 - 2.4%) as illustrated by (**Jame *et al.*, 1978**), expect the previous mentioned treatments. The obtained results are in contrast with those found by **Poniedzialek *et al.*, (1995)** on apple mentioned that PP_{333} gave the highest concentration of N in the leaves.

Regarding to leaf phosphorus content, it is clear that slight effect to both growth retardants materials was noticed. The highest values of leaf phosphorus content was obtained with S-3307D at 2000 ppm sprayed at full bloom and S-3307D 1000 ppm sprayed at Mid-May. Generally, it could be concluded that leaf P content of treated apple trees with PP_{333} or S-3307D was within the optimum level 0.1-0.3% which illustrated by (**Jame *et al.*, 1978**) these obtained data are in contrast with those found by **Poniedzialek *et al.*, (1995)** on apple said that paclobutrazol application reduced content of P in Gloster cv. trees.

Potassium leaf content of 'Anna' apple trees treated with PP_{333} or S-3307D at different rates and dates was greatly affected. Deficient of leaf K content was noticed with control, S-3307D 2000 ppm at full bloom and PP_{333} at Mid-May. The other treatment gives values within

Table (11): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on Nitrogen, Phosphorus, Potassium and Calcium in leaves of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	1996 Season				1997 Season			
	Nitrogen	**Phosphorus**	**Potassium**	**Calcium**	**Nitrogen**	**Phosphorus**	**Potassium**	**Calcium**
Control	2.133 BCD	0.13 EF	0.91 D	2.30 E	2.20 CD	0.13 E	0.91 F	2.57 EF
PP_{333} 1000 F.B.	1.89 D	0.26 B	1.06 CD	2.93 D	1.93 E	0.25 C	1.04 DF	2.97 C
PP_{333} 2000 F.B.	1.98 CD	0.16 DE	1.16 BC	2.33 E	2.03 DE	0.18 D	1.23 BC	2.43 F
S-3307D 1000 F.B.	2.05 CD	0.12 F	1.00 CD	2.70 D	2.01 DE	0.13 E	1.08 DE	2.53 EF
S-3307D 2000 F.B.	2.03 CD	0.31 A	0.95 CD	2.77 D	2.03 DE	0.30 A	0.95 EF	2.87 CD
S-3307D 1000 F.B. + PP_{333} 1000 M.May	1.94 CD	0.21 C	1.02 CD	4.00 AB	1.95 DE	0.20 D	1.00 DF	3.83 AB
S-3307D 2000 F.B. + PP_{333} 1000 M.May	2.03 CD	0.21 C	1.09 CD	2.87 D	2.06 DF	0.21 D	1.11 CD	2.87 CD
PP_{333} 1000 M.May	2.22 BC	0.19 CD	0.99 CD	2.77 D	2.40 BC	0.21 D	0.99 DF	2.70 DE
PP_{333} 2000 M.May	2.73 A	0.27 AB	1.43 A	3.40 C	2.70 A	0.27 BC	1.52 A	3.73 B
S-3307D1000 M.May	2.37 B	0.30 A	1.33 AB	3.80 B	2.50 AB	0.29 AB	1.30 B	3.63 B
S-3307D2000 M.May	2.83 A	0.29 AB	1.53 A	4.27 A	2.63 AB	0.27 AC	1.47 A	4.03 A

Means have the same letter(s) in a column are not differ significantly at a 5% level.

Table (12): Effect of spraying Paclobutrazol (PP_{333}) and uniconazole (S-3307D) on Magnesium, Iron, Zinc and Manganeze in leaves of "Anna" apple trees during 1996 and 1997 seasons.

Treatments	1996 Season				1997 Season			
	Magnesium	Iron (ppm)	Zinc (ppm)	Manganeze (ppm)	Magnesium	Iron (ppm)	Zinc (ppm)	Manganeze (ppm)
Control	0.36 C	64.00 G	37.00 E	22.33 F	0.36 CE	64.33 H	37.00 F	22.30 F
PP_{333} 1000 F.B.	0.34 C	66.00 FG	41.33 CD	26.75 D	0.34 E	68.33 GH	41.00 E	29.83 E
PP_{333} 2000 F.B.	0.35 C	67.00 FG	45.00 B	22.97 EF	0.34 E	66.33 G	44.67 D	22.99 H
S-3307D 1000 F.B.	0.40 B	86.00 C	38.67 DE	23.98 E	0.38 BC	83.67 C	38.33 F	23.97 G
S-3307D 2000 F.B.	0.34 C	69.00 F	41.00 CD	25.50 D	0.40 AB	72.00 F	41.00 E	25.53 F
S-3307D 1000 F.B. + PP_{333} 1000 M.May	0.32 C	77.67 D	41.33 CD	34.07 A	0.37 CD	76.33 E	41.67 E	33.99 A
S-3307D 2000 F.B. + PP_{333} 1000 M.May	0.36 C	81.00 D	37.33 E	26.73 D	0.34 DE	80.00 D	36.67 F	26.66 E
PP_{333} 1000 M.May	0.35 C	74.00 E	44.00 BC	28.87 C	0.35 DE	73.33 EF	44.33 D	28.88 D
PP_{333} 2000 M.May	0.40 B	95.00 AB	52.67 A	31.53 B	0.34 E	90.33 B	51.67 C	31.33 C
S-3307D1000 M.May	0.42 AB	93.33 B	54.00 A	32.64 B	0.41 AB	92.33 B	53.67 B	32.55 B
S-3307D2000 M.May	0.45 A	98.00 A	55.00 A	34.33 A	0.42 A	97.00 A	56.00 A	34.33 A

Means have the same letter(s) in a column are not differ significantly at a 5% level.

the optimum level (1.2%) which illustrated by (**Jame *et al.*, 1978**). The obtained results are in line with those found by **Martin *et al.*, (1988)** and **George *et al.*,** (1995) on peach who reported that PP_{333} decrease leaf K. On contrary, **Poniedzialek *et al.*, (1995)** on apple mentioned that PP_{333} increased K in leaves.

Data concerning leaf Ca content showed that excessive values of leaf Ca content were obtained with all treatments including control than optimum values (1.0%) when illustrated by (**Jame *et al.*, 1978**). The highest values of leaf Ca content was obtained with the treatment of S-3307D 1000 ppm at full bloom followed by 1000 ppm PP_{333} at Mid-May whereas the least value was obtained with 2000 ppm PP_{333} at full bloom. Such findings are in accordance with the previous results obtained by **Poniedzialek *et al.*, (1995)** on apple who found that PP_{333} increased Ca in leaves of Gloster cv.

Leaf Mg contents data showed that there were an increase in all treatments than adequate value (0.25) % which illustrated by (**Jame *et al.*, 1978**) S-3307D 2000 ppm sprayed at Mid-May produced leaves with high Mg content than other treatments. The great effect to PP_{333} and S-3307D as growth retardant materials on leaf Mg content attributed to their effect on leaf expansion ( ) which become more green dark. The results obtained here are in line with those found by **Poniedzialek *et al.*, (1995)** on apple that PP_{333} increase Mg in leaves of Melrose cv. On contrary, PP_{333} reduced Mg in leaves of Gloster and Jonagold cvs. trees.

Data related to leaf Fe-Zn and Mn contents declare that Fe and Mn values were within optimum values (60-100 ppm and 20 ppm respectively) which illustrated by (**Bose *et al.*, 1988, Jame *et al.*, 1978**)

S-3307D 2000 ppm sprayed at Mid-May produced leaves with highest Fe and Mn contents than other treatments. The obtained results are in line with the findings of **Monge *et al.*, (1995)** on peach who said that PP_{333} increased Fe and Mn. On the other hand, it is clear that there were an excessive value of leaf Zn content than optimum value (18ppm) which mentioned by (**Jame *et al.*, 1978**). The great effect to used growth retardants (PP_{333} and S-3307D) on leaf micronutrient content mainly attributed to producing small leaves with high content of these micro elements.