IV. RESULTS AND DISCUSSION

Effect of Soil management systems on:

IV –1. Weeds control

The growing weeds in Anna apple orchard during the two experimental seasons were: 1)- Broad leaved weeds, *e.g.Urtica urens*, (Small nettle), *Chenopodium* sp. (lamb's quarter), *Portulaca olearceae* (purslane), *Xanthium* spp. (cock lebur), *Solanum nigrum* (Black night shade), *Convolvulus arvensis* (Bind weed or morning glory) and *Rumex dentatus* (curly dock); 2)- Grassy leaved weeds, *e.g. Cynodon dactylon* (Bermuda grass), *Cyperuse rotundus* (Nutgrass) and *Echinochloa colonum* (jungle rice).

However, **Tables (1 & 2)** show that mulch treatments were more effective in decreasing weeds growth since they decreased significantly dry weight of either broad or grassy weeds. Moreover, herbicides and clean cultivation treatments were less effective than mulch treatments in a descending order.

Concerning mulch sources used in this study, it is found that field crop residues mulch was more effective than rice straw in decreasing dry weight of either broad or grassy weeds Anyhow, the difference was so high to be significant.

Referring to clean cultivation treatments, it is obvious that twice clean cultivation (control) induced statistically the highest effect in decreasing dry weight of weeds followed by once clean cultivation and no cultivation treatments in a descending order.

Further more, as herbicide treatments were concerned, it is quite evident that weeds treated with Glyphosate herbicide were more affected since Glyphosate treatments decreased dry weight of grassy weeds and total dry weight as compared with the other two herbicides *i.e.* Afolon's and Paraquat in the meantime, Afalon's herbicide was more effective than Paraquat in get rid of weeds since it decreased dry weight of weeds more than Paraquat herbicide.

Generally, the above mentioned results indicate that mulching treatments are more effective in weed control parameters than the other soil management systems used.

These results are in general agreed with the findings of **Helail (1981 & 1993), Gut *et al.*, (1991) and Marks, (1993).** They recommended straw mulching for weeds control in most orchards of fruit crops.

Moreover **Helail (1993)** claimed that clean cultivation had lower effect in controlling annual weeds in pear orchard. Besides, **Young (1983),** declared that weed control was improved with increasing Glyphosate dose from 0.56 to 1.12 and 2.24 kg/ha for cv. Golden Delicious apple orchard.

Table (1): Effect of weed control treatments on weeds dry weight (g/m^2) of apple orchard during 1996 and 1997 seasons.

Measurements	Dry weight (g)				Total dry weight (g)	
	Broad leaved		Grassy			
Treatments	1996	1997	1996	1997	1996	1997
Twice clean cultivation (control)	3.65 E	7.97 E	42.62 D	24.81 E	46.27 E	32.78 D
Once clean cultivation	6.69 B	13.95 B	54.62 B	49.61 B	60.94 B	63.56 B
No cultivation	16.93 A	27.99 A	97.16 A	67.21 A	114.10 A	95.10 A
Field crop residues mulch	1.00 G	6.57 G	2.86 H	1.54 G	3.85 H	8.11 H
Rice straw mulch	0.38 H	8.76 D	4.33 G	0.47 H	4.71 G	9.23 G
Glyphosate herbicide	5.05 C	10.78 C	6.38 F	9.20 F	11.42 F	19.98 F
Afalon's herbicide	2.34 F	0.56 H	50.85 C	30.90 D	53.19 C	31.46 E
Paraquat herbicide	6.53 C	7.46 F	40.64 E	42.19 C	47.17 D	49.65 C

Means followed by the same letter within each column for each category are not significantly different from each other at 5% level.

Table (2): Effect of weed control treatments on weeds dry weight (g/m^2) of Anna apple orchard (Average of 1996 and 1997 seasons).

Measurement / Treatments	Dry weight (g)		Total dry weight (g)
	Broad leaved	Grassy	
Twice clean cultivation (control)	5.81 E	33.72 E	39.53 E
once clean cultivation	10.32 B	51.93 B	62.45 B
No cultivation	22.46 A	82.14 A	104.60 A
field crop residues mulch	3.78 G	2.20 H	5.98 H
Rice straw much	4.57 F	2.40 G	6.97 G
Glyphosate herbicide	7.92 C	7.79 F	15.7 F
Afalon's herbicide	1.45 H	40.88 D	42.33 D
Paraquat herbicide	7.00 D	41.42 C	48.42 C

Means followed by the same letter within each column for each category are not significantly different from each other at 5% level.

IV.2. Horticultural measurements:

IV.2.1. Vegetative growth:

Concerning number of shoots per branch of Anna apple trees, **Table (3) and Fig. (1)** indicate that mulch cultivation treatments significantly surpassed clean cultivation and herbicide treatments in a descending order. Moreover, rice straw treatment gave highest value than field crop residues in this respect. Such result was more true in the first season.

Similarly, twice clean cultivation treatment (control) had the first rank among the other two clean cultivation treatments used in this study, which were similar statistically. Comparing herbicide treatments, it is clear that Glyphosate herbicide was more superior than the other two herbicides used in increasing number of shoots. However, such increase was not so high to reach the significant level.

These results coincide with those obtained by **Rahovic and Petrovic (1977); Chiba *et al.*, (1975); Ruger (1991) and Luchkov *et al.*, (1989).** They found that mulching gave the best growth. Besides, **Johnson and Samuelson (1990)** concluded that all herbicides application had a negligible effect on apple tree growth.

In addition, **Rupp and Anderson (1985)** claimed that hand weeded treated plots of Tart cherry trees had greater growth than those did in paraquat-treated plots'.

Regarding shoot length increase as shown in **Table (3) and Fig. (2),** it is quite evident that mulch treatments significantly surpassed the other treatments used in this study in their effect on increasing shoot length followed by herbicide and clean cultivation treatments in a descending order.

Considering mulch materials, it is clear that rice straw succeeded in increasing shoot length more than field crop residues treatment. Anyhow, the difference was insignificant. Moreover, Twice clean cultivation treatment (control) was the superior one in this respect as compared with the other two clean cultivation treatments under study without any significancy. On the other hand, data of herbicide treatments disclosed that Glyphosate herbicide treatment was the highest treatment in increasing shoot length increase in spite of the difference was not significant.

These results are in general agreement with the findings of **Luchkov *et al.*, (1989).** They reported that mulching increased apple tree growth on M - 9 rootstock (trunk diameter, shoot length and total shoots length).

Stojanowska (1987) found that apple trees growing in rows mulched with black foil were larger than those under the herbicide treatments.

Moreover, **Crisp and Alkinson (1984)** reported that foliar application of Glyphosate had more severely affected on growth of plum trees than of apple.

Concerning leaf area, it is clear from **Table (3)** that mulch treatments generally increased leaf area over the other treatments used under study. On the other side, herbicide treatments took the second rank in this respect followed by clean cultivation treatments.

Considering each group of soil management systems solely, data showed that trees received once clean cultivation treatment was more effective in increasing leaf area as compared to the other two treatments used. However, such effect was not statistically noticed.

Similarly, trees treated with Paraquat herbicide succeeded in increasing leaf area as compared with the other two herbicides used in this study.

No significant difference was mostly obtained between rice straw and field crop residues used as mulch materials.

Referring to leaf dry weight, it is quite evident from **Table (3) and Fig. (3)**, that mulch treatments gave the heaviest leaves followed by herbicide and clean cultivation treatments in a descending order in most cases.

Moreover, leaves of trees treated with rice straw mulch were heavier in their dry weight than those ones of trees mulched with field crop residues but without any significancy. Besides, control trees i.e. twice clean cultivation, surpassed significantly one clean cultivation and no cultivation treatments in their leaf dry weight. On the other hand, data of herbicide treatments showed that trees treated with Paraquat had leaves with higher values of dry weight among the other two herbicides used. However, the difference was so small to be significant. These results are in general agreement with the findings of **Helail (1981)**. He reported that mulch treatment caused the largest increase in shoot length, leaves number, leaf dry weight and leaf area of Washington navel orange trees.

In addition, **Xu *et al.*, (1983)**, claimed that film mulching of young apple trees in the first ten days of May followed by grass mulching in the second half of the month, increased shoot length and width of the shoot tip by 121.6% and 103.4%, respectively.

Table (3): Effect of soil management systems on vegetative growth of Anna apple trees during 1996 and 1997 seasons.

Measurement	No. of shoots /branch		Shoot length increase (cm)	Leaf area (cm^2)		Leaf dry weight (gm)	
Treatment	1996	1997	1997	1996	1997	1996	1997
Twice clean cultivation (control)	13.58 AB	18.07 AB	18.36 EFG	26.81 D	24.00 A	0.33 A	0.35 A
Once clean cultivation	11.61 CD	13.61 C	17.67 FG	28.03 CD	30.20 A	0.21 BC	0.26 B
clean cultivation	11.85 C	13.61 C	16.60 G	27.30 CD	28.77 A	0.18 C	0.21 C
Field crop residues mulch	12.23 BC	19.38 A	28.70 AB	29.93 BC	33.50 A	0.32 A	0.35 A
Rice straw mulch	15.39 A	18.01 B	32.10 A	33.57 A	30.03 A	0.36 A	0.35A
Glyphosate herbicide	10.55 CD	12.63 CDE	24.40 BCD	30.13 BC	28.30 A	0.29 AB	0.28 B
Afalon's herbicide	10.52 CD	10.71 E	22.67 DE	31.20 AB	27.40 A	0.28 ABC	0.27 B
Paraquat herbicide	9.55 E	11.50 DE	23.40 CD	33.20 AB	30.70 A	0.30 AB	0.30 AB

Means followed by the same letter within each column for each category are not significantly different from each other at 5% level.

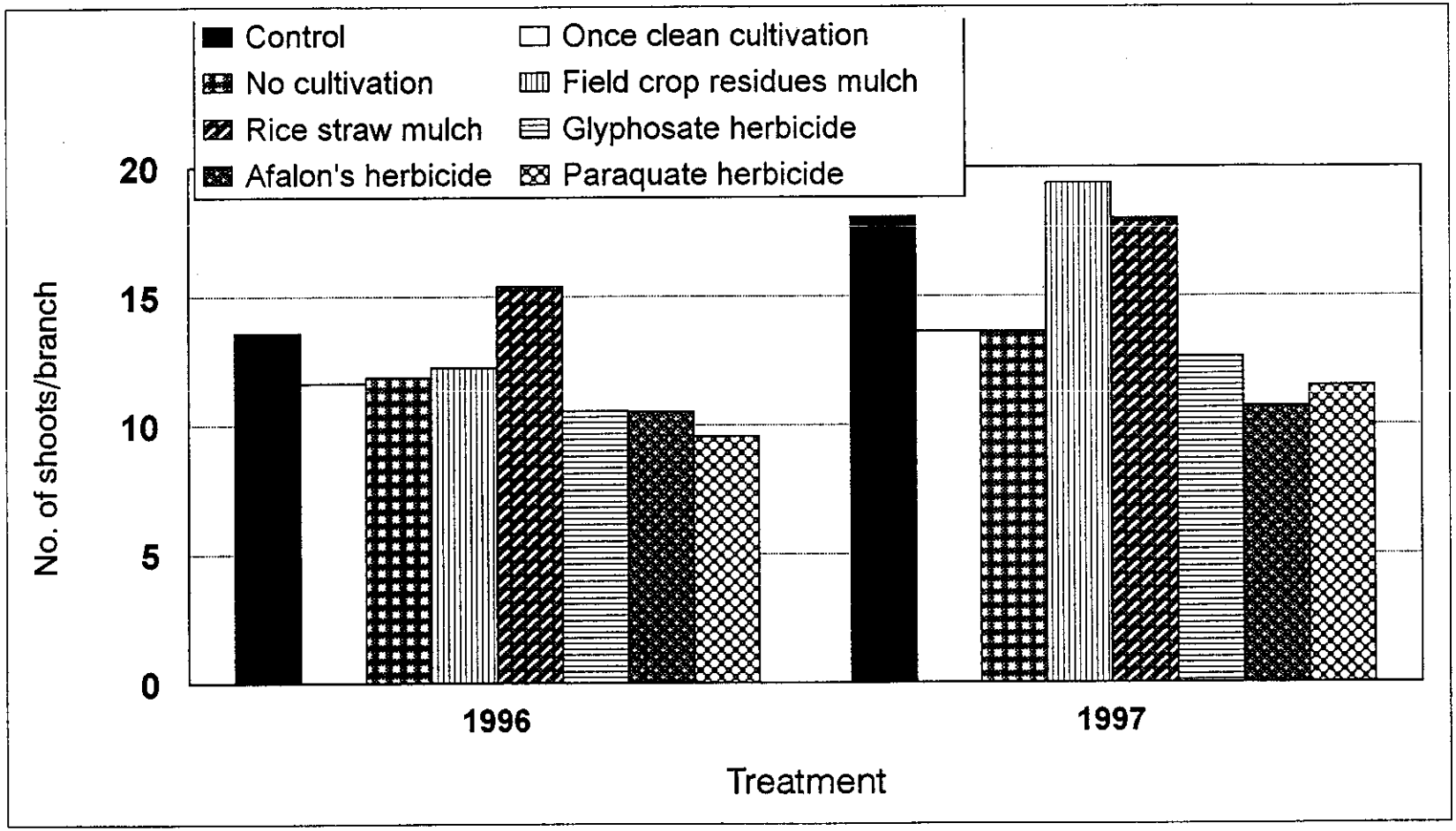

Fig. (1): Effect of soil management systems on number of shoots per branch of Anna apple trees.

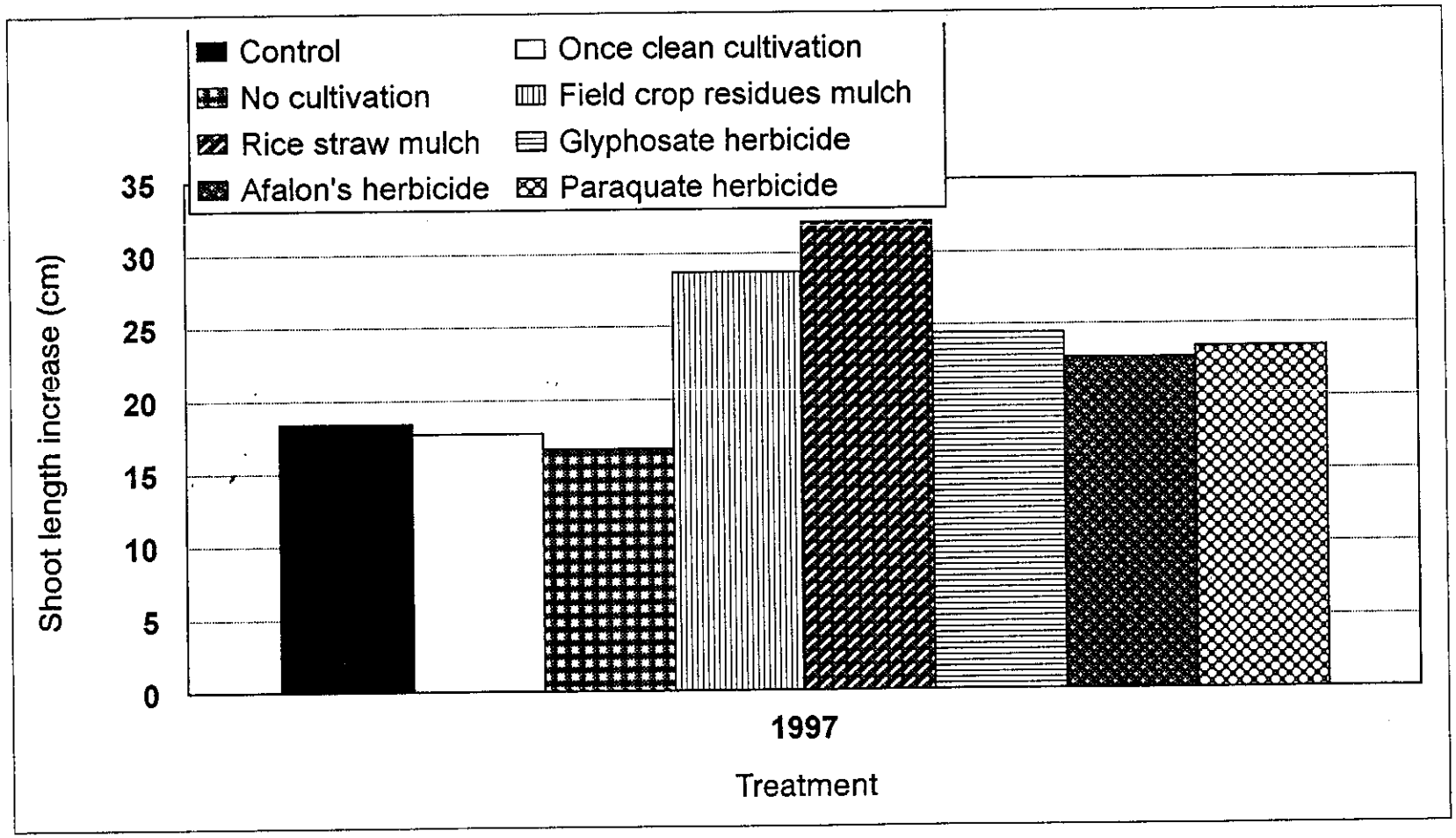

Fig. (2): Effect of soil management systems on shoot length increase (cm) of Anna apple trees.

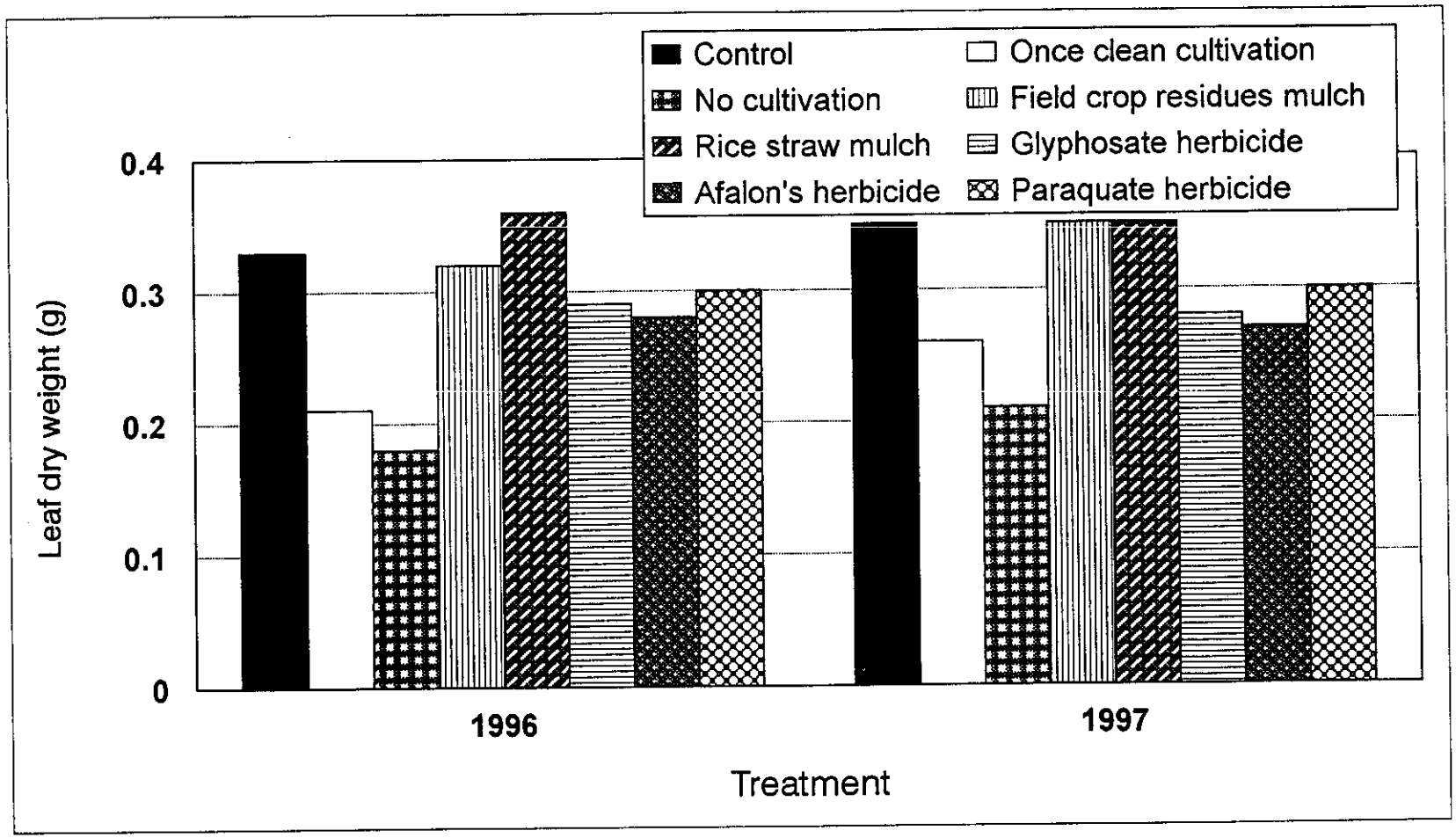

Fig. (3): Effect of soil management systems on leaf dry weight (g) of Anna apple trees.

IV.2.2. Effect of soil management systems on leaf nutrient contents.

A. As Percentage and p.p.m.:

It is clear from **Table (4-A)** that mulch cultivation treatments among the other treatments used under study succeeded in increasing leaf N, K and Zn while failed to increase leaf content of P, Ca, Mg, and Fe. On the other hand, clean cultivation treatments surpassed in general the other treatments in increasing leaf Mg and Mn while they were intermediate in leaf N, P, Ca, Fe and Zn contents. Concerning herbicide treatments, it is obvious that these treatments increased leaf content of P, Ca and Fe while they failed to increase leaf N, Zn and Mn.

Comparing the two sources of mulch, data disclosed that rice straw mulch was mostly superior in raising up leaf Fe, Zn and Mn contents. On the other hand, leaves of trees treated with field crop residues had higher amounts of N, P, Ca and Mg.

Furthermore, herbicide treatments indicated that Paraquat succeeded in increasing leaf Mg, Zn, and Mn nutrients while Afalon's increased in general leaf Mg and Fe contents. On the Other hand, Glyphasate herbicide induced the highest amounts of leaf P and K contents.

Considering clean cultivation treatments, it is found that twice-clean cultivation treatment (control) induced an increase in leaf Ca and K nutrients while once clean cultivation treatment increased only Mg and Fe nutrients. Moreover, no cultivation treatment stimulated statistically leaf Zn and Mn nutrients. These

results are in general agreed with the findings of **Helail (1981), Mustaffa (1988) and Tolhurst (1973).** They reported that mulch treatments increased leaf N, P, K, Ca, Mn and Mg contents. In addition, **Lenz and Bunemann (1975)** and **Bristol (1980)** showed that leaf N, P and K contents were lower with mechanical weed control.

B. As absolute value (mg/leaf)

Considering leaf absolute value of nutrients as presented in **Table (4-B)** data clearly showed that mulch treatments as compared with the other treatments used in this study augmented visually leaf N, K, Ca, Mg and Fe nutrients while clean cultivation treatments, on the other hand, failed to realize any success in increasing leaf N, P, Ca and Fe nutrients. Moreover, herbicide treatments succeeded only in raising up leaf P nutrient.

Comparing the two sources of mulch under study it is found that field crop residues increased mostly leaf N, P, Ca, Mg and Fe contents as compared with the corresponding ones of those treated with rice straw mulch. Concerning clean cultivation system, data indicate that once clean cultivation treatment surpassed no cultivation treatment in increasing leaf N, P, Ca, Mg and Fe contents.

Furthermore, herbicide treatments showed that Glyphosate increased leaf N and P while Paraquat raised up K, Ca and Mg in leaves.

Table (4-A): Effect of soil management systems on leaf nutrients content (as percentage and p.p.m., on dry weight basis) of Anna apple trees during 1996 and 1997 seasons.

Measurements	Percentage										Part per million (p.p.m)					
Nutrients	N		P		K		Ca		Mg		Fe		Zn		Mn	
Treatment	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Twice clean cultivation (control)	1.20 B	1.38 A	0.31 B	0.31 A	1.12 A	1.57 A	5.36 AB	3.85 CD	1.47 A	0.34 C	153.00D	98.00G	43.67CD	31.00 C	26.33 H	24.67 E
Once clean cultivation	1.55 A	1.28 A	0.31 B	0.31 A	0.89 A	1.31 A	3.65 D	4.08 BC	1.32 A	0.74 A	172.33B	131.33E	46.00CD	53.33 B	29.00 G	55.00 B
Clean cultivation	1.57 A	1.27 A	0.44 B	0.31 A	0.89 A	1.24 A	3.92 D	4.62 A	1.14 A	0.75 A	140.33E	119.00F	49.00CD	54.33 B	61.33 A	68.00 A
Field crop residues mulch	1.67 A	1.33 A	0.38 B	0.31 A	1.20 A	1.72 A	5.44 AB	3.87 CD	1.56 A	0.63 B	162.67C	172.00A	72.33AB	62.67 A	49.00 C	25.34 E
Rice straw mulch	1.47 AB	1.32 A	0.27 B	0.31 A	1.18 A	1.73 A	3.74 D	3.58 D	1.23 A	0.72 A	190.67A	158.33B	82.33A	57.00AB	56.67 B	28.00 E
Glyphosate herbicide	1.47 AB	1.18 A	0.86 A	0.42 A	0.95 A	1.54 A	5.51 C	4.03 BC	1.00 A	0.71 A	135.00F	150.00C	31.67D	34.33 C	31.67 F	28.33 E
Afalon's herbicide	1.48 AB	1.25 A	0.31 B	0.31 A	0.92 A	1.51 A	5.74 A	3.96 CD	1.01 A	0.79 A	170.33B	142.33D	47.33CD	21.67 D	40.33 E	35.33 D
Paraquat herbicide	1.38 B	1.28 A	0.43 B	0.31 A	1.01 A	1.46 A	4.94 BC	4.39 AB	1.09 A	0.73 A	128.33G	116.67F	60.67BC	58.33AB	44.67 D	45.00 C

Means followed by the same letter within each column for each category are not significantly different from each other at 5% level.

Table (4-B): Effect of soil management systems on absolute value of leaf nutrients content (as mg/leaf, on dry weight basis) of Anna apple trees during 1996 and 1997 seasons.

Measurements	Absolute value of leaf nutrients (mg/leaf)															
Nutrients	N		P		K		Ca		Mg		Fe		Zn		Mn	
Treatment	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Twice clean cultivation (control)	3.96 D	3.66 C	1.02 D	1.08 D	3.70 C	5.49 B	17.68 A	13.47 B	4.85 B	1.19 E	0.05 B	0.03 CD	0.01 A	0.01 A	0.01 A	0.01 A
Once clean cultivation	3.25 E	3.32DE	0.65 F	0.80 B	1.27 H	3.40 E	7.66 G	10.61 G	2.77 F	1.92 C	0.04 BC	0.03 CD	0.01 A	0.01 A	0.01 A	0.01 A
Clean cultivation	2.82 F	2.67 F	0.79 E	0.65 E	1.60 E	2.60 F	7.05 H	9.70 H	2.05 G	1.57 D	0.03 C	0.02 D	0.01 A	0.01 A	0.01 A	0.01 A
Field crop residues mulch	5.34 A	4.65 A	1.12 C	1.08 B	1.60 G	6.02 A	17.40 B	13.54 A	5.00 A	2.20 B	0.05 B	0.06 B	0.02 A	0.02 A	0.02 A	0.01 A
Rice straw mulch	5.29 A	4.62 A	0.97 D	1.08 B	4.24 A	6.05 A	13.46 E	12.53 D	4.43 C	2.50 A	0.07 A	0.05 AB	0.03 A	0.02 A	0.02 A	0.02 A
Glyphosate herbicide	4.26 B	3.30 E	2.50 A	1.18 A	2.75 E	4.31 C	13.08 F	11.28 E	2.90 E	1.98 C	0.04BC	0.04 BC	0.01 A	0.01 A	0.01 A	0.02 A
Afalon's herbicide	4.14 C	3.37 D	0.86 E	0.84 D	2.60 F	4.07 D	16.07 C	10.69 F	2.83EF	2.13 B	0.05 B	0.04 BC	0.01 A	0.01 A	0.01 A	0.01 A
Paraquat herbicide	4.14 C	3.84 B	1.30 B	0.93 C	3.03 D	4.38 C	14.82 D	13.17 C	3.27 D	2.19 B	0.04 BC	0.03 CD	0.02 A	0.02 A	0.01 A	0.01 A

Means followed by the same letter within each column for each category are not significantly different from each other at 5% level.

These results are partially in line with the findings of **Helail (1981)** who found that rice straw mulch system increased leaf Mg, Mn, Fe and Zn of citrus. In addition, **Hudska (1990)** concluded that leaf K and Mg contents increased in the plots of apple and some stone fruit trees treated with mulch.

Besides, **Bristol (1980)** found that apple Golden Delicious trees had leaves with lower level of K under clean cultivation. He added that apple Golden Delicious trees had leaves with lower level of N under herbicide treatments (Terbacil at the rate of 3kg/ha, Simazine + Paraquat at the rate of 2.5 kg /ha + 1.0 kg /ha).

IV.2.3. Fruiting

IV.2.3.a. Fruit set and dropping

It is clear from **Tables (5 & 6) and Figs. (4 & 5)** that mulch treatments gave the highest percentage of fruit set and consequently lowest percentage of fruit dropping followed by clean cultivation and herbicide treatments in a descending order. However, the difference between values of clean cultivation treatments from one-hand and herbicide treatments on the other was not so high to be noticed. Any how, such results were predicted since mulch as organic matter increase water holding capacity of the soil and add more available nutrients to the soil which increase fruit set and decrease fruit drop simultaneously.

These results some what agreed with the findings of **Thakur *et al.*, (1993).** They Found that mulching with black polyethylene

resulted in the highest fruit set (8.89%) and lowest fruit drop (30.12%) in apple cv. Red Delicious.

In addition **Helail (1981)** found that mulching with Rice straw resulted in the highest fruit set (19.21) and lowest fruit drop (13.51) of young Washington navel fruits.

Concerning the two sources of mulch used in this study rice straw treatment was more promising than field crop residues treatment in increasing fruit set and decreasing fruit drop. Nevertheless, the difference between these treatments was not statistically noticed.

On the other hand, clean cultivation treatments showed that twice-clean cultivation treatment (control) surpassed the other two treatments under study in increasing and decreasing fruit set and fruit drop, respectively. Such result was more statistically obvious between control treatment (twice-clean cultivation) and no cultivation treatment.

Concerning herbicide treatments, data indicate that Afalon's treatment among the other two herbicide treatments used in this study *i.e.* Glyphosate and Paraquat herbicides was more preferable in this respect in the first season. Such effect was not statistically noticed as fruit dropping was concerned.

These results agreed with the findings of **Jawanda *et al.*, (1977).** They pointed out that dalapon, Gramaxone, bromacil, atrazine applied with various rates at pre–harvest increased fruit drop except Gramaxone which reduced it.

Table (5): Effect of soil management systems on fruit set percentage of Anna apple trees.

Treatment	Fruit set %	
	1996	1997
Twice clean cultivation (control)	21.23 BC	22.83 A
Once clean cultivation	20.50 C	20.03 BC
No cultivation	17.27 D	18.60 C
Field crop residues mulch	22.47 AB	22.93 A
Rice straw mulch	23.20 A	24.26 A
Glyphosate herbicide	17.57 D	20.13 BC
Afalon's herbicide	21.30 BC	18.73 C
Paraquat herbicide	18.03 D	20.93 B

Means followed by the same letter within each column for each category are not significantly different from each other at 5 % level

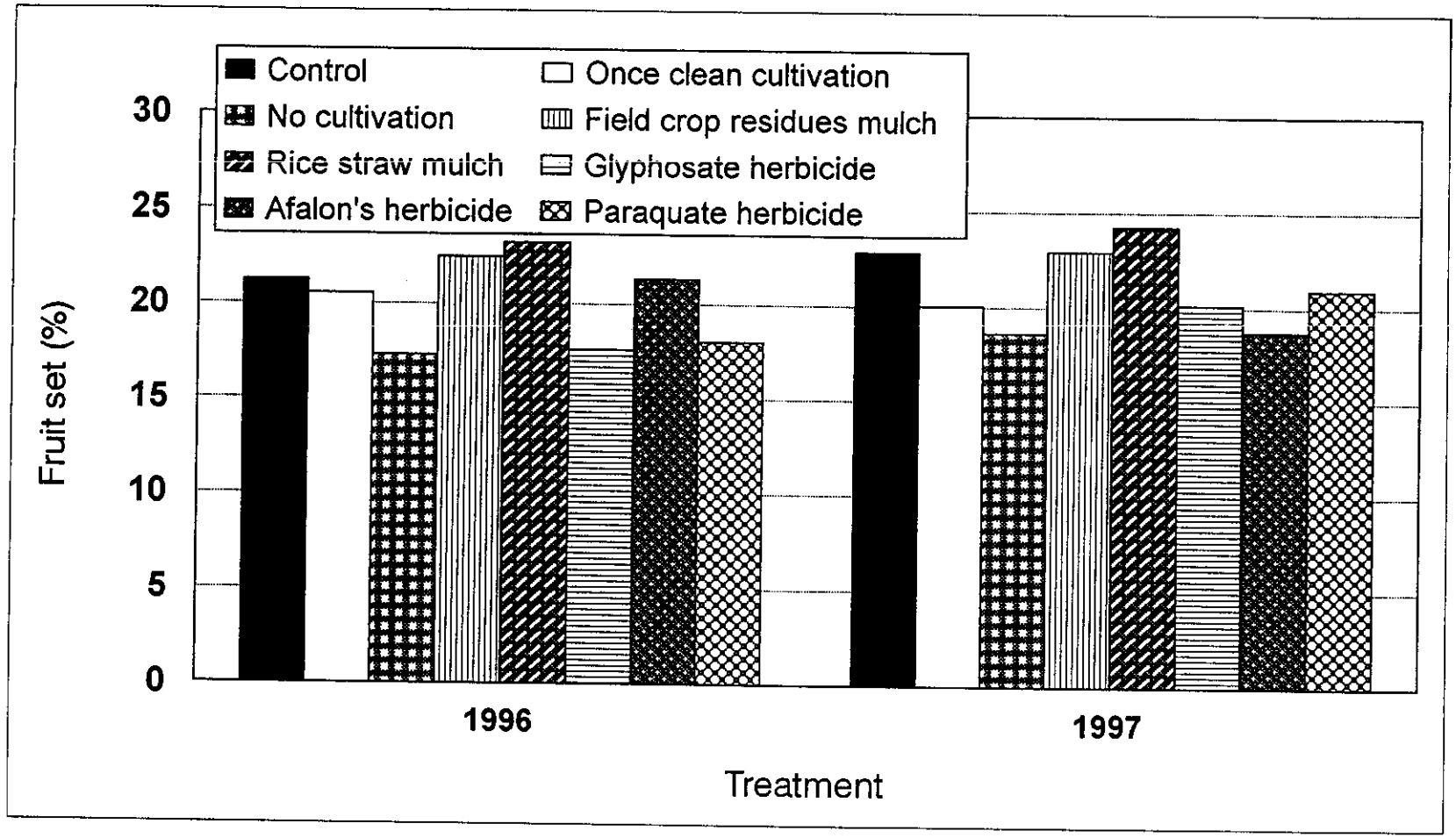

Fig. (4): Effect of soil management systems on fruit set percentage of Anna apple trees.

Table (6): Effect of soil management systems on fruit drop percentage of Anna apple trees.

Treatment	Fruit drop %	
	1996	1997
Twice clean cultivation (control)	72.73 BC	70.77 B
Once clean cultivation	76.27 AB	76.90 A
No cultivation	79.20 A	77.30 A
Field crop residues mulch	71.17 C	70.45 B
Rice straw mulch	70.20 C	69.17 B
Glyphosate herbicide	78.57 A	75.43 A
Afalon's herbicide	76.83 AB	73.33 AB
Paraquat herbicide	77.70 A	76.47 A

Means followed by the same letter within each column for each category are not significantly different from each other at 5 % level

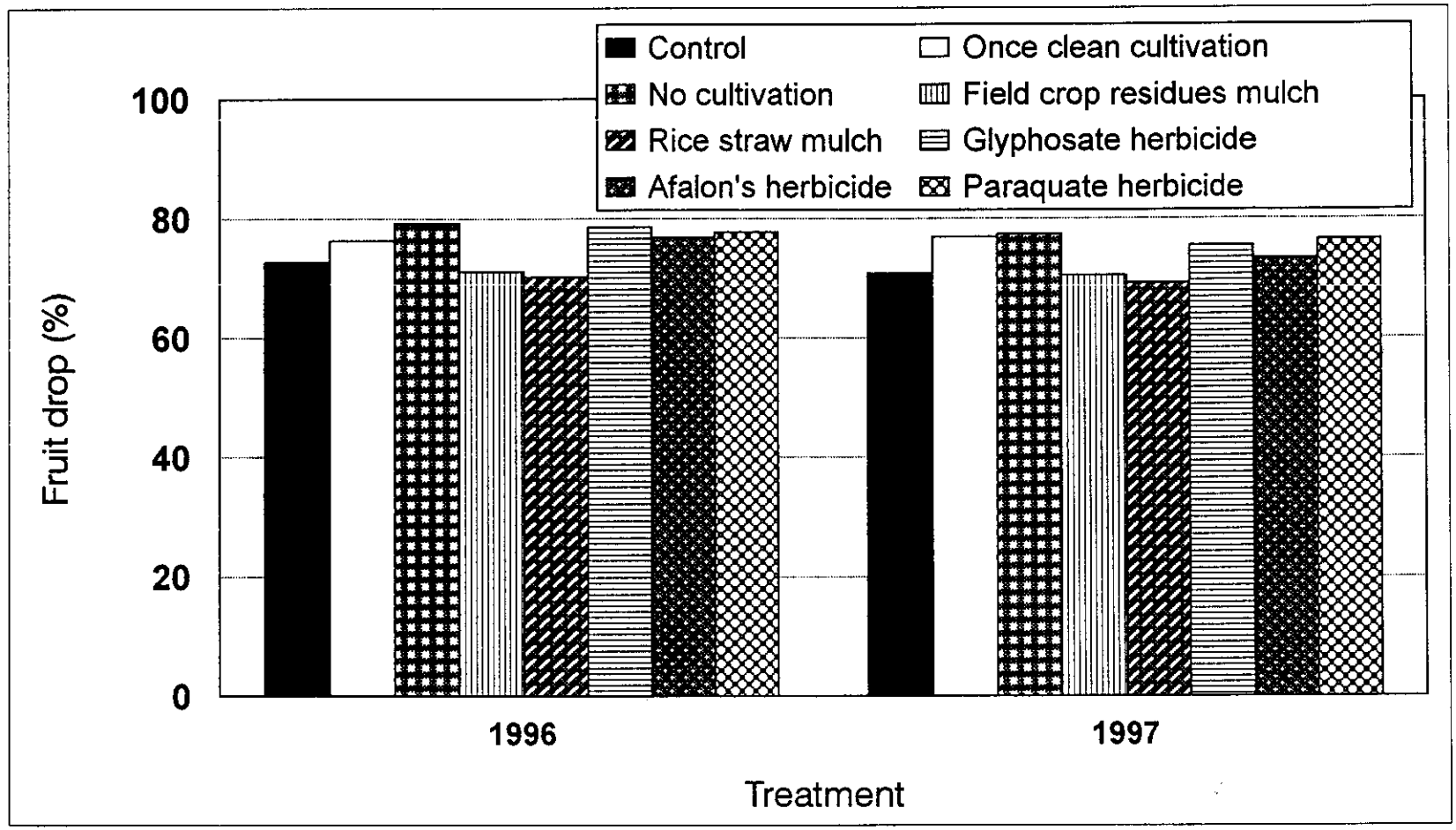

Fig. (5): Effect of soil management systems on fruit drop percentage of Anna apple trees.

IV.2.3.b. Yield and fruit quality

IV.2.3.b.1. Yield.

Yield of Anna apple trees was expressed in **Table (7) and Figs. (6 & 7)** as kg and number of fruits per tree. It is well noticed that mulch treatments gave significantly the highest yield among the other treatments used in this study i.e. herbicide and clean cultivation treatments in a descending order.

However, no significant difference was noticed between the two sources of mulch under study i.e field crop residues and rice straw in this respect.

Moreover, clean cultivation System showed that trees received once clean cultivation treatment was the highest one among the other two used treatments.

Considering herbicide treatments, it is quite evident that Glyphosate succeeded in raising up the yield significantly among the other two tested herbicides. On the contrary, Afalon's treatment was inferior statistically in this sphere

These results agreed with the findings of **He and Yu (1992), Niggli *et al.*, (1988), Ruger (1991) and Baxter (1970).** They found that best results were obtained with mulching, treatment, which increased yield of apple trees.

Moreover, **Maslov (1979)** cited that removing the grass from the orchard of 8 years-old apple trees depressed the yield slightly. **Spasov and Gurnevski (1980),** used 10 kg/ha, dalapon and the inter- row spaces were cultivated twice for cv. Golden Delicious apple trees. They found that under this treatment the yield was reduced.

Table (7): Effect of soil management systems on fruits number and yield (Kg) per tree of Anna apple during 1996 and 1997 seasons.

Measurement	No. of fruits / tree		Yield (Kg)/tree	
Treatment	1996	1997	1996	1997
Twice clean cultivation (control)	184.00 BC	149.00 D	20.63 C	18.47 D
Once clean cultivation	216.67 B	233.33 BC	27.47 B	30.00 B
No cultivation	145.67 C	102.00 A	18.70 C	13.43 E
Field crop residues mulch	331.33 A	309.33 A	42.90 A	38.93 A
Rice straw mulch	324.67 A	305.00 A	43.17 A	38.47 A
Glyphosate herbicide	289.00 A	245.00 B	38.60 A	31.00 B
Afalon's herbicide	154.50 C	112.33 E	20.47 C	15.63 DE
Paraquat herbicide	221.67 B	211.67 C	22.60 BC	25.83 C

Means followed by the some letter within each column for each category are not significantly different from each other at 5 % level

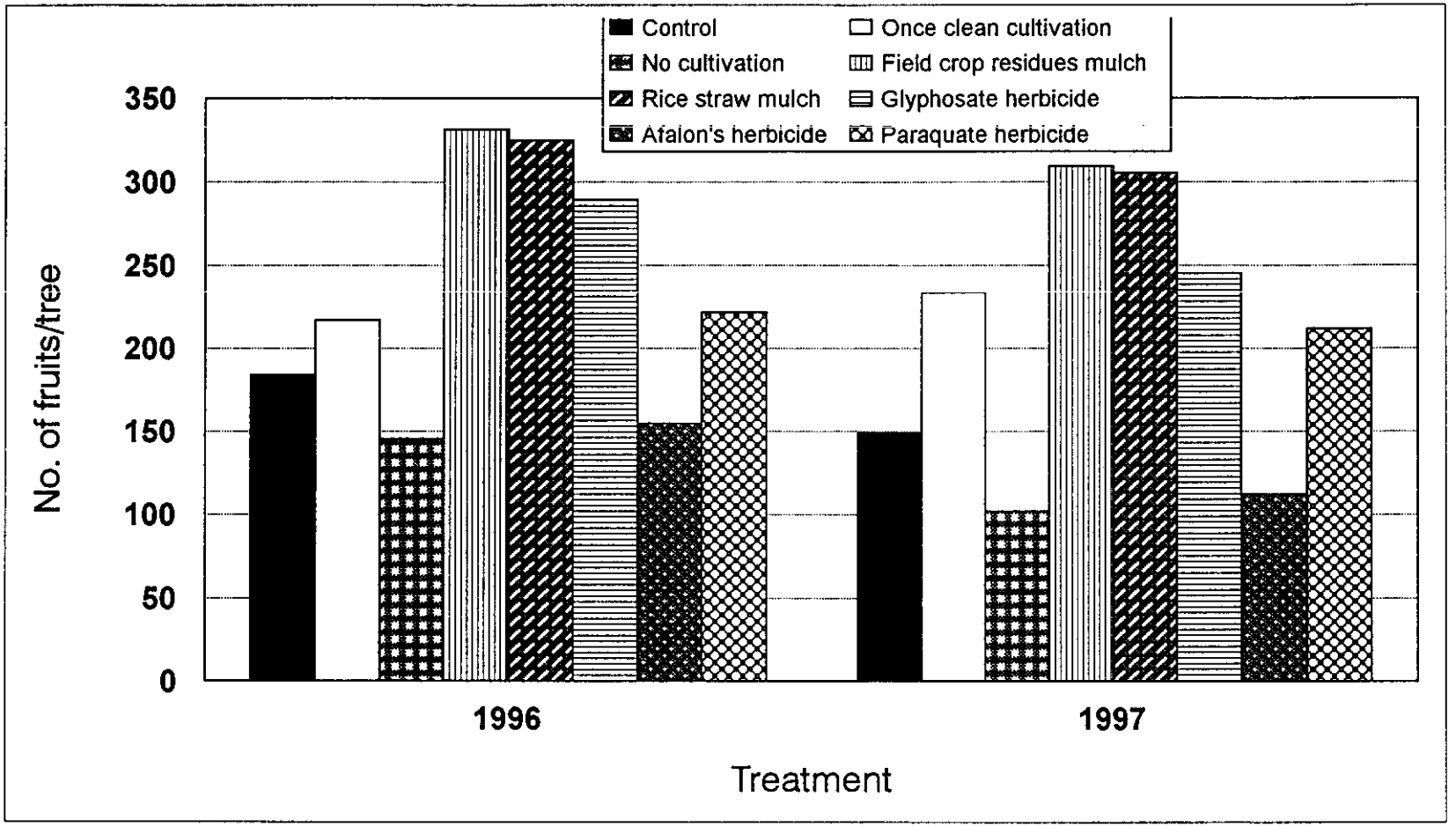

Fig. (6): Effect of soil management systems on number of fruits/tree of Anna apple.

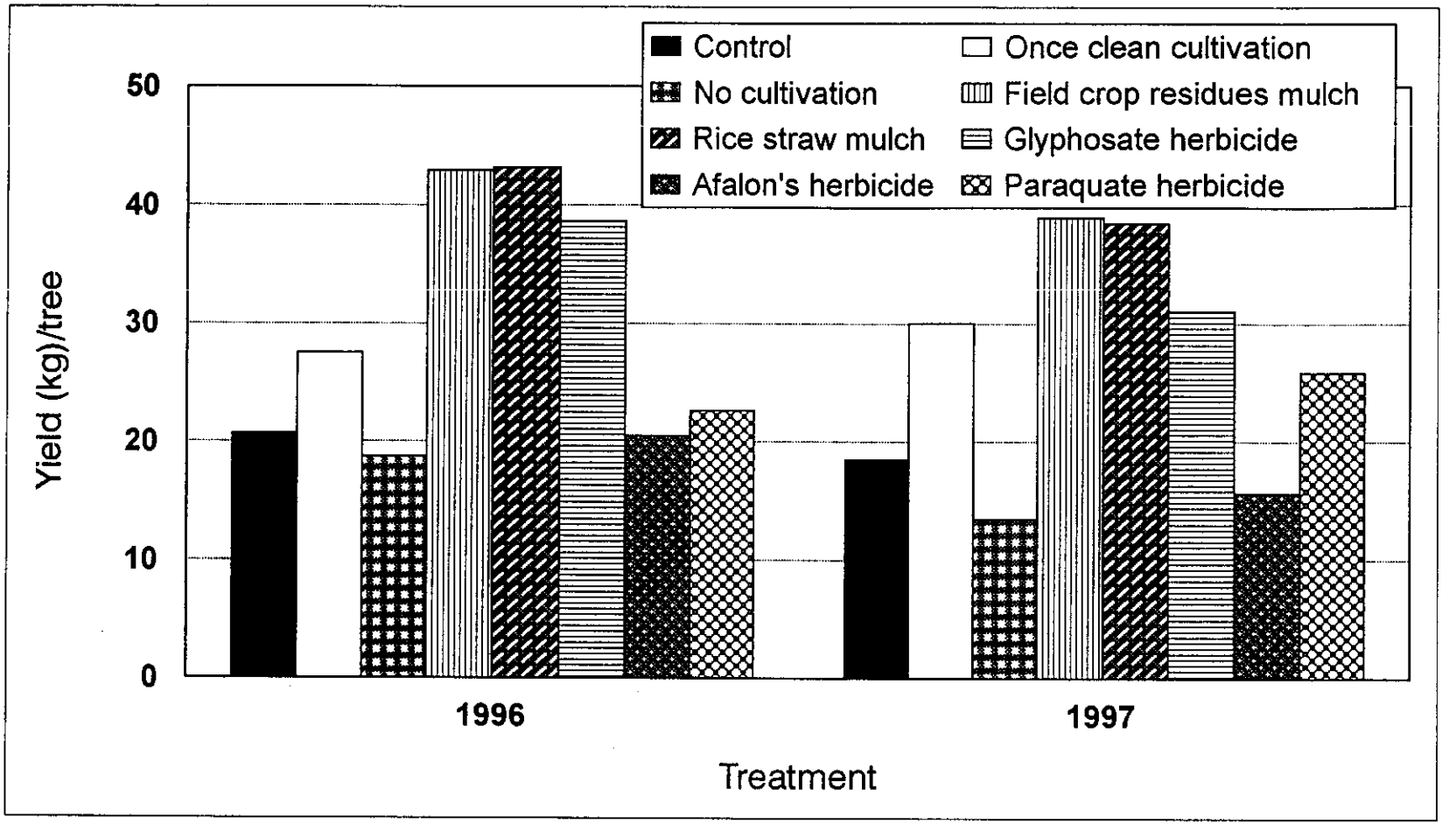

Fig. (7): Effect of soil management systems on yield (kg) per tree of Anna apple.

IV.2.3.b-2- Fruit quality

1- Physical properties:

1.a. Fruit weight: -

Data tabulated in **Table (8) and** illustrated in **Fig. (8)** disclosed that fruit weight of mulched trees was heaviest remarkably as compared with both clean cultivation and herbicide systems.

Referring to different sources of mulch used, it is clear that rice straw mulch gave fruits heavier in their weight than those of field crop residues mulch. The difference was so high to be significant. Besides, data of herbicides showed that Glyphosote herbicide, mainly in the second season, gave fruits more superior in their weight than those of Afalon's and paraquat. The difference between values of Glyphosate and Paraquat in 1997 season were significant.

On the Other hand, clean cultivation treatments showed that once clean cultivation treatment succeeded in producing fruits heaviest in their weight than those produced from either twice-clean cultivation (control) or no cultivation. Such effect was clearer in the second season of study. However, the difference between twice-clean cultivation and no cultivation treatment was statistically significant, in both seasons.

1.b. Fruit size:

Table (8) and Fig. (9) show that mulch treatments succeeded in increasing fruit size visually while herbicide treatments failed to realize any success in this respect. Moreover, clean cultivation treatments were in between in this sphere.

Concerning each group solely, it is clear that field crop residues mulch treatment mainly in the second season, gave largest fruits than those of rice straw mulch system.

Regarding herbicide treatments, data showed that Paraquat herbicide in the first season caused significant increase in fruit size than those of both Glyphosate and Afalon's herbicides, which gave statistically similar values in this respect.

Furthermore, no cultivation treatment gave in both seasons smallest fruits in their size as compared with both twice-clean cultivation and once clean cultivation treatments, which produced statistically fruits more or less similar in their size.

1.c. Fruit firmness: -

It is clear from **Table (8)** that in general fruit firmness was not affected by different soil management systems used since data fluctuated from one season to another. Nevertheless, data showed that rice straw mulch treatment gave fruits more soft than those of field crop residues. Such effect in both seasons was significant. Similarly, once clean cultivation treatment gave fruits more soft as compared with both twice-clean cultivation and no cultivation treatments. Moreover, as herbicide treatments were concerned no steady trend was obtained in both seasons.

These results agreed with the findings of **Baxter (1970)**, who reported that peach trees growing in straw mulched strips 3m.and Apple trees grown under 1.5m wide mulched strips produced fruits larger in their weight and size than the cultivated trees.

Moreover, **Thakur *et al.*, (1993)** found that mulching with black polyethylene resulted in the heaviest individual fruit weight (156.6g) and fruit size of apple cv. Golden Delicious.

Table (8): Effect of soil management systems on physical properties of Anna apple fruits.

Measurement	Fruit weight (g)		Fruit size (cm^3)		Firmness ($L/inch^2$)	
Treatment	1996	1997	1996	1997	1996	1997
Twice clean cultivation (control)	132.13 BC	108.43 CD	165.27 A	160.87 AB	11.31 B	10.07 B
Once clean cultivation	130.20 CD	128.70 B	161.00 AB	164.23 A	10.20 C	8.77 CD
No cultivation	121.67 E	101.40 D	151.97 BC	127.10 E	12.57 A	8.67 CD
Field crop residues mulch	183.73 B	130.63 B	168.87 A	169.00 A	11.67 AB	11.83 A
Rice straw mulch	154.93 A	142.17 A	169.13 A	155.13 B	10.10 C	8.33 D
Glyphosate herbicide	127.10 CDE	125.40 B	150.70 BC	135.73 CD	12.80 A	8.17 D
Afalon's herbicide	122.50 DE	114.30 C	148.02 C	139.63 C	11.37 B	9.00 BCD
Paraquat herbicide	134.03 BC	110.43 CD	165.33 A	129.40 DE	11.97 AB	9.80 BC

Means followed by the same letter within each column for each category are not significantly different from each other at 5% level.

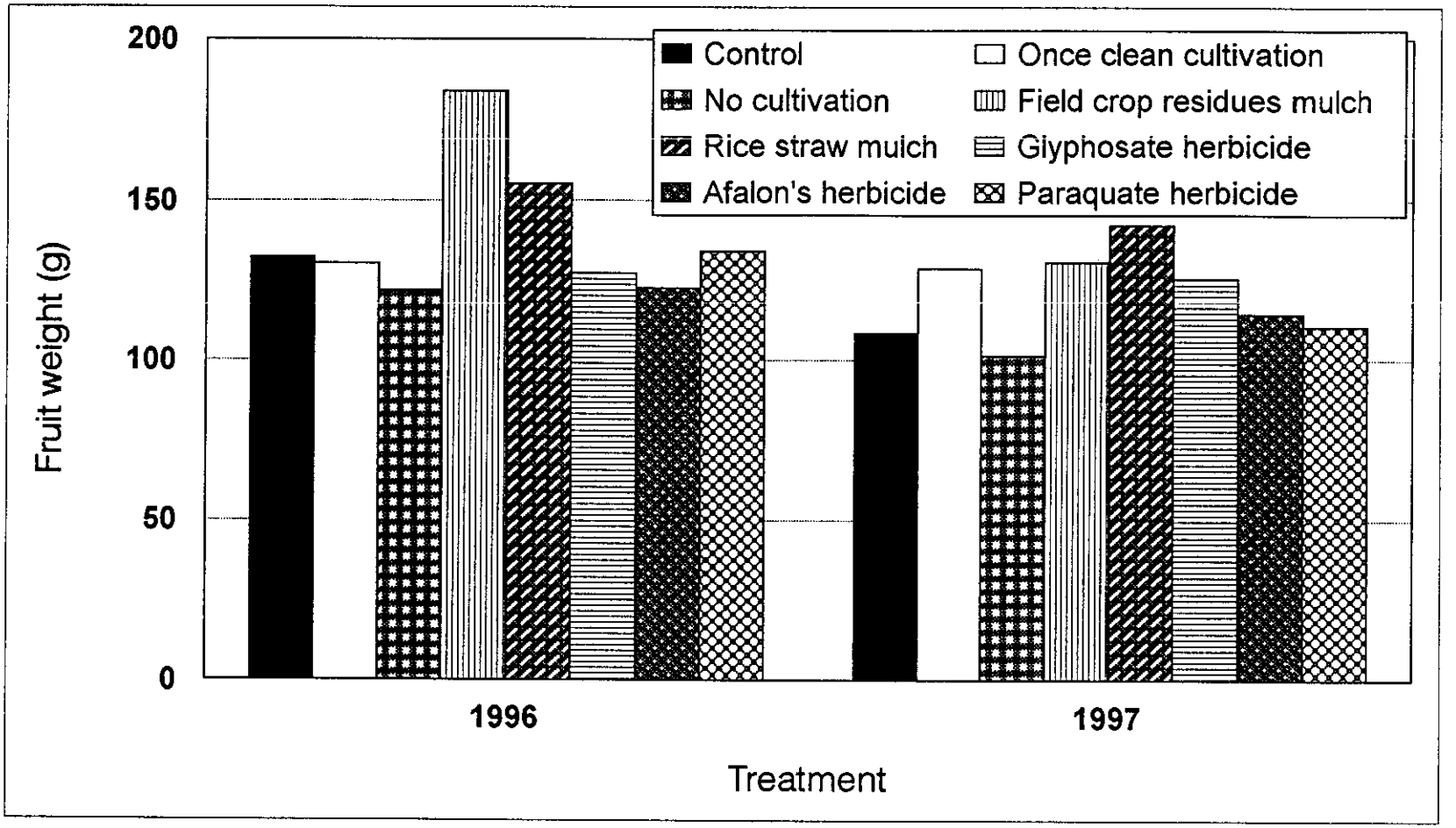

Fig. (8): Effect of soil management systems on fruit weight (g) of Anna apple trees.

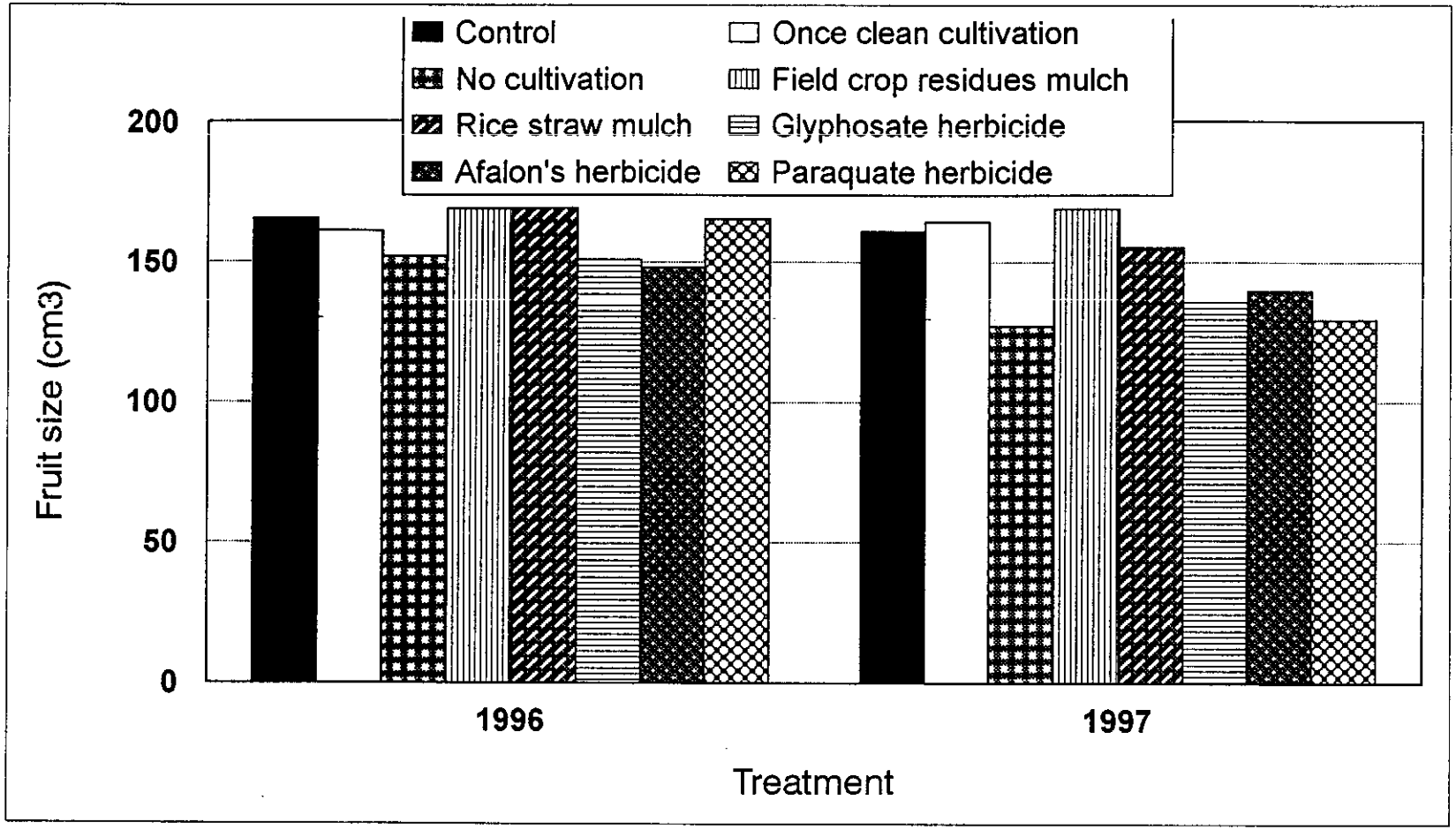

Fig. (9): Effect of soil management systems on fruit size (cm^3) of Anna apple trees.

2. Chemical properties:

2.a. Titratable acidity:

It is clear from **Table (9)** that both mulch and herbicide treatments gave generally lowest values of acidity as compared with clean cultivation treatments.

Meanwhile, rice straw mulch gave fruits with lowest values in respect of those of field crop residues. However, the difference was so high to be significant.

Concerning herbicide treatments, data disclosed that trees received Glyphosate gave fruits poorest in acidity comparing with the other two herbicides used in this study.

Referring to clean cultivation treatments it is found that once clean cultivation treatment followed by twice clean cultivation treatment succeeded in decreasing acidity in fruits as compared with no cultivation treatment.

2.b- T.S.S.

A glance to **Table (9)** indicate that the difference between values of fruit T.S.S. of the three groups of soil management systems was not so high to be noticed.

Nevertheless, mulch treatments disclosed that rice straw mulch gave fruits with higher values of T.S.S. than the corresponding ones of those treated with field crop residues. Such result was true from the statistical pointed of view.

Regarding, herbicide treatments, it is clear that fruits of Glyphosate herbicide mainly in the second season had highest values of T.S.S. as compared with the other two herbicides used in this study which were similar in their values statistically.

Concerning clean cultivation system, T.S.S. values of different treatments were statistically similar in their values.

2.c. Total sugars:

Considering total soluble sugars, it is found that mulch treatments mainly rice straw mulch, gave fruits with higher total soluble sugars content in respect of both herbicide and clean cultivation systems which they nearly similar in their values in this concern **(Table, 9) and Fig. (10)**. Meanwhile, rice straw mulch gave fruits with higher amount of total sugars than those of field crop residues. In the same time, herbicide treatments showed that Afalon's in the first season augmented total sugars comparing with the other two herbicides under study. The picture was changed to the reverse in the second season.

Referring to clean cultivation treatments, it is obvious that fruits of once clean cultivation treatment in the first season had highest values in this respect comparing with the other two treatments in this field.

2.d. Starch :

Concerning fruit starch content, data in **Table (9) and** clarified in **Fig. (11),** disclosed that mulch treatments mainly rice straw mulch gave lowest values among the other two systems of soil management, which they as overage, were nearly similar in their values. However, fruits of field crop residues treatment were higher in their content comparing with those of rice straw treatment.

In the same side, Paraquat herbicide increased fruit starch among the other two herbicides used. Moreover, as clean cultivation

system was concerned, data indicate that twice clean cultivation treatment (control) in the second season had fruits with highest amounts of starch. Such effect was not clearly noticed in the first season since this treatment gave lowest value when compared with no cultivation treatment.

2.e. Starch/Sugars ratio:

It is found from **Table (9) and Fig. (12)** that rice straw mulch gave lowest value of starch : sugars ratio as compared with both clean cultivation and herbicide systems.

However, field crop residues treatment increased starch/sugars ratio over rice straw mulch treatment. Comparing clean cultivation treatments, data showed that no cultivation treatment in the first season gave the highest value. The *vice verse* was obtained in the second season.

Considering herbicide treatments, it is clear that Paraquat treatment gave mostly fruits with higher starch/sugars ratio in respect of the other two herbicides used.

These results agreed with the findings of **He and Yu (1992), Baxter (1970) and Niggli *et al.*, (1988)**. They mentioned that best results were obtained with mulching which increased fruit quality compared with conventionally employed herbicides.

Shergill (1993) said that two sprays of diuron at the rate of 6 Kg/ha slightly increased the sugar and ascorbic acid contents in juice of citrus fruits. In addition **Rahovic and Petrovic (1974),** found that clean cultivation gave the little effect on fruit quality and advanced ripening of Peach-fruits by 2 days.

Table (9): Effect of soil management systems on chemical properties of Anna apple fruits.

Measurement	Tiratable Acidity %		T.S.S %		Total sugars %		Starch %		Starch / sugars ratio	
Treatment	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Twice clean cultivation (control)	0.65 C	0.72 F	10.87ABC	10.5 CD	8.17 B	6.23 BC	10.91BC	15.07 A	1.33 F	2.42 A
Once clean cultivation	0.85 C	0.74 E	11.00 AB	11.0 BC	8.67 B	6.53 BC	10.38 C	9.42 D	1.20 G	1.44 G
No cultivation	0.91 A	0.84 B	10.80 ABC	11.00 BC	4.07 C	7.50 A	13.66 A	9.22 D	3.35 A	1.23 E
Field crop residues mulch	0.68 B	0.87 A	10.20 CD	10.03 D	7.40 B	5.73 C	12.84 ABC	13.80 B	1.73 D	2.41 A
Rice straw mulch	0.48 D	0.72 F	11.33 A	11.67 AB	8.86 A	8.20 A	6.48 D	8.31 DE	0.73 H	1.01 F
Glyphosate herbicide	0.62 C	0.59 G	10.13 D	12.17 A	4.07 C	8.37 A	10.84 BC	7.38 E	2.66 B	0.88 G
Afalon's herbicide	0.65 C	0.76 D	10.87 ABC	10.93 BC	7.93 B	6.50 BC	11.91 ABC	11.20 C	1.50 E	1.72 C
Paraquat herbicide	0.74 B	0.82 C	10.47 BCD	10.83 C	6.53 BC	6.50 BC	13.11 AB	11.65 C	2.01 C	1.79 B

Means followed by the same letter within each column for each category are not significantly different from each other at 5 % level

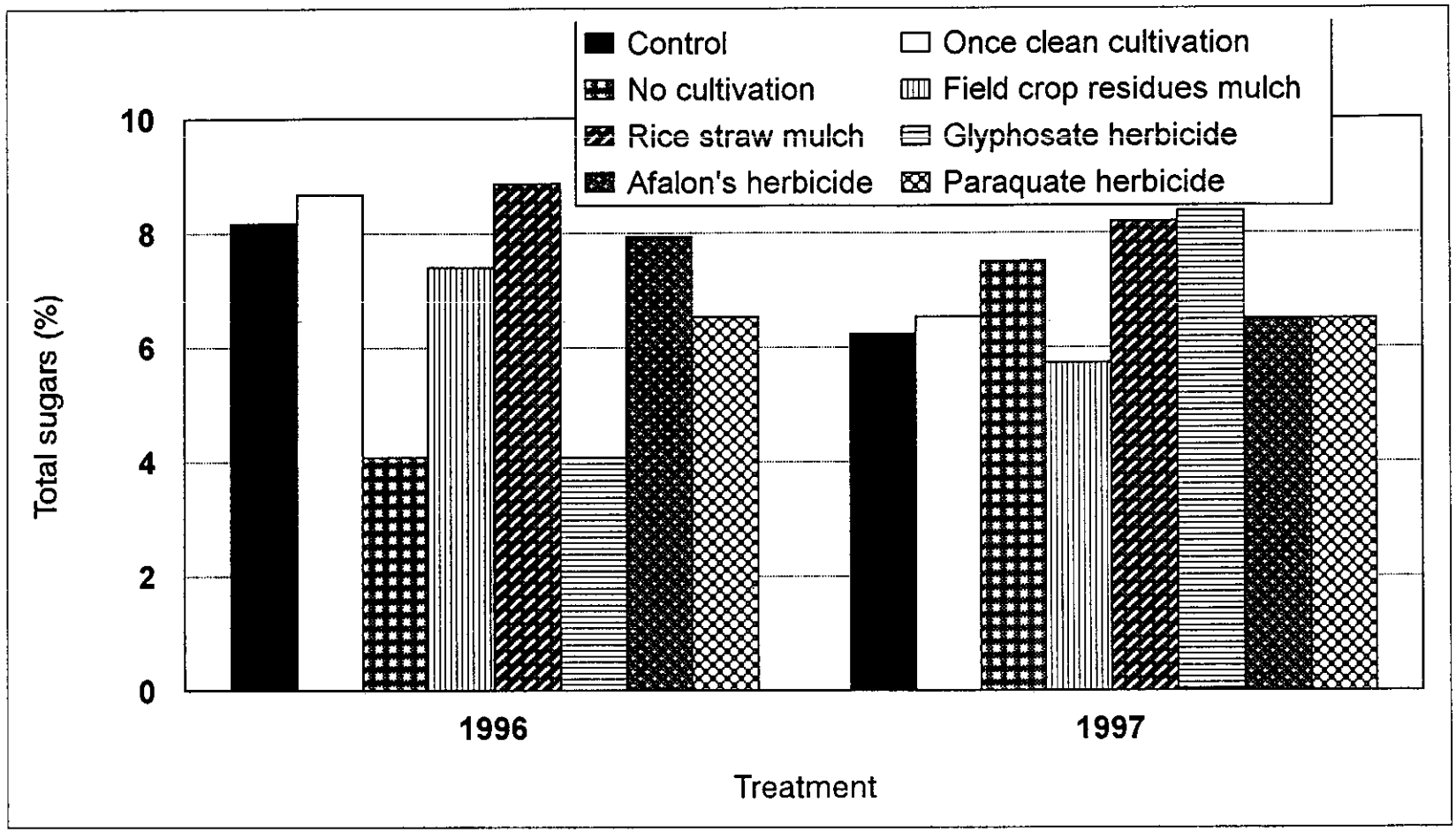

Fig. (10): Effect of soil management systems on total sugars (%) of Anna apple fruits.

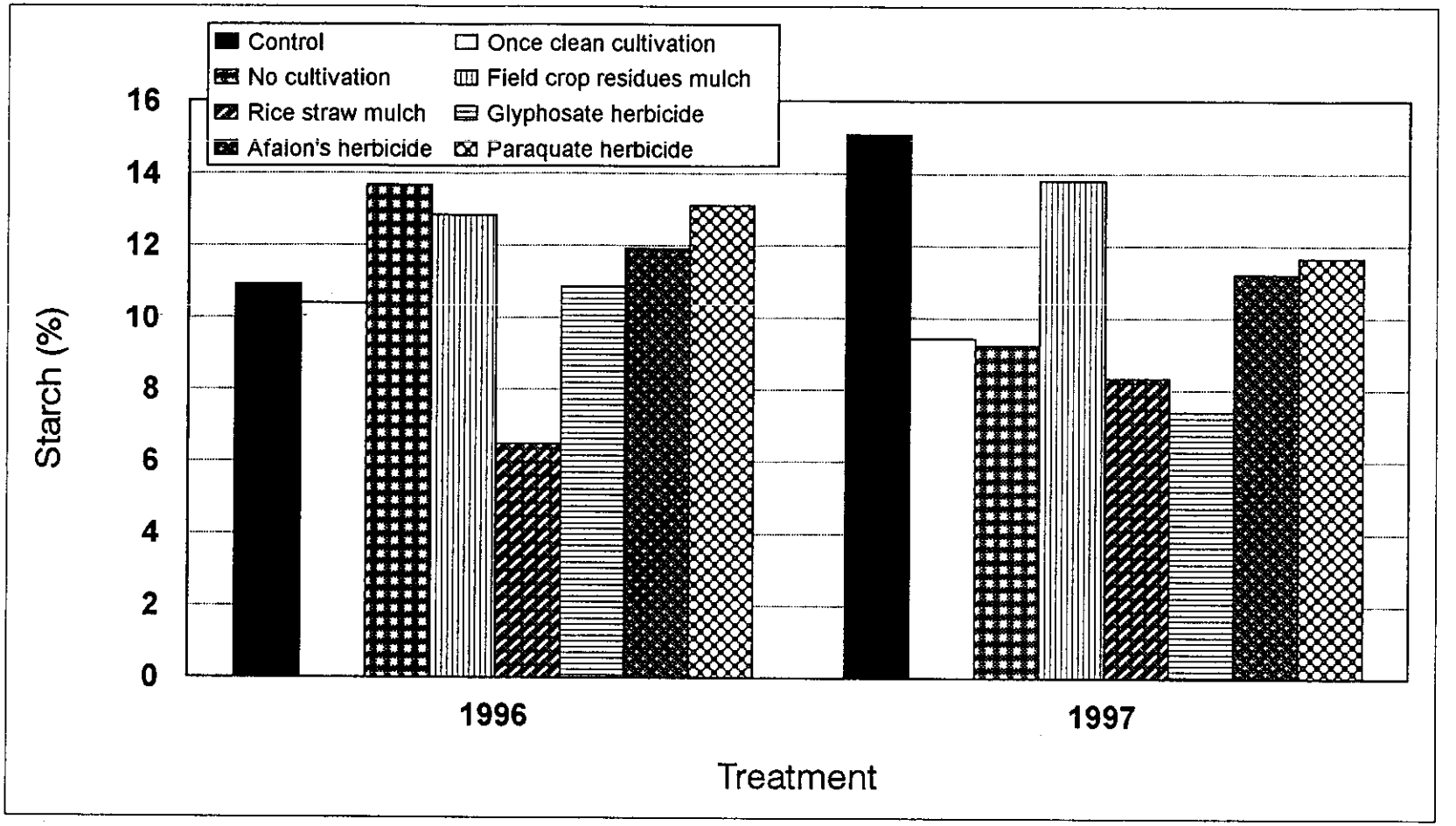

Fig. (11): Effect of soil management systems on fruit starch percentage of Anna apple trees.

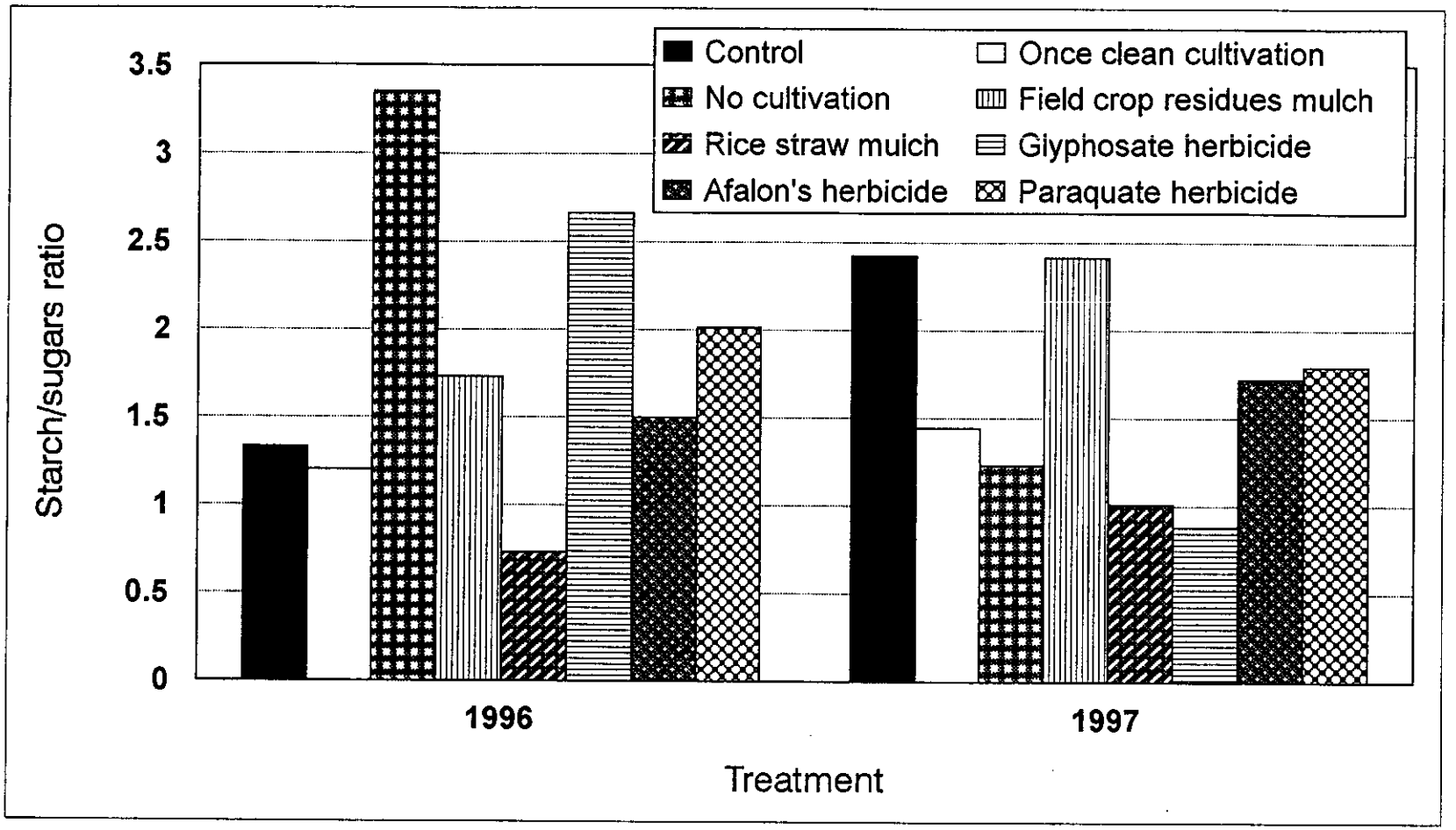

Fig. (12): Effect of soil management systems on fruit starch/sugars ratio of Anna apple trees.

IV.3. Herbicidal Fruit residues

Table (10) indicated that, both Glyphosate and Paraquat had no residues in fruits of Anna apple. On the other hand, a detectable amount of Afalon's herbicide existed in fruits (0.080 – 0,082 p.p.m). In this respect, the use of Glyphosate, labeled in different positions, enabled the following degradative pathway to be suggested first, Glyphosate is degraded to amino-methyl phosphonate and 2–C natural product, probably glyoxylate aminomethyl phosphonate is then degraded by transmission to formyl phosphonate which decomposes to formaldehyde and in organic phosphate. Formaldehyde can then be incorporated either directly into natural metabolites or by further decomposition to carbon dioxide with subsequent photochemical re-fixation. Use of glycine-2-C^{14} labeled Glyphosate confirmed the expected greater incorporation of the label into natural products compared to the glycine-1-C^{14} label. The reason is that the C-1 position of glyoxylate has the potential to be eliminated as carbon dioxide in the glyoxylate and citric acid cycles, whereas the C-2 position is usually incorporated into several intermediate natural products and therefore is retained in the metabolite pool. Although loss of C^{14} from the plants was predicated in this way, no data were presented confirming or quantifying this. On the other hand, Paraquat can easily metabolize in plants. Similar results was reported by **Putnam (1976)** who discovered two C^{14} – labeled compounds in apple and pear trees 90 days after treatment with C^{14} Glyphosate.

The majority of the C^{14} activity was associated with Glyphosate (92 - 97%), but small amounts of aminomethyl phosphonic acid (1 - 7 %) were detected. In addition, **Harrington *et al.*, (1992)** found that Glyphosate and amitrole were the most commonly used knockdown herbicides, while triazines (particularly simazine and terbuthylazine and terbumelon) were the most popular residual herbicides. These results agreed with the findings of **Harrington *et al.*, (1992).** They found that Glyphosate was the most commonly used knockdown herbicides, while triazines (particularly, simazine, terbuthylazine and terbumelon) were the most popular residual herbicides.

In addition, **Jordan and Russell (1979)** stated that 8 – 16 lb/acre Glyphosate caused negligible harvest residues in citrus fruits.

Table (10): Herbicidal fruit residues (p.p.m) of Anna apple trees during seasons of 1996 and 1997

Herbicide	1996	1997
Glyphosate	Nd	Nd
Afalon's	0.080	0.082
Paraquat	Nd	Nd

(Nd) = Not detectable

IV.4. Soil microbial organisms

It is quite evident from **Table (11) and Figs. (13 & 14)** that mulch treatments increased the activity of bacteria in the soil as compared with twice-clean cultivation (control) treatment.

Moreover, field crop residues mulch was more effective in increasing total bacterial counts than rice straw mulch treatment. Besides, growth period of total bacteria increased up to 120 days in mulch treatments then decreased afterwards whilst in twice clean cultivation (control) treatment such increase in growth period of total bacteria extended only to 90 days. These results are in general agreement with the findings of **Murray (1921)** who showed that straw applied to the soil stimulated the reproduction of bacteria. As the straw increased, bacteria also increased in numbers. In addition, **Jedrzejewska (1955),** stated that Organic materials increased the total number of bacteria and actinomycetes in the soil. He added that the increase in the number of bacteria was more pronounced than that of actinomycetes.

Furthermore, **Table (12) and Figs. (15 & 16)** disclosed that actinomycetes counts in the soil increased till 120 days of growth period then decreased afterwards up to 180 days. That was true in the control and both mulch treatments. Moreover, field crop residues mulch increased the activity of actinomycetes in the soil than rice straw mulch. These results are in general agreement with the findings of **Nilson (1957)** who reported that the number of actinomycetes were twice as high in manured soil rich in organic matter as compared with un manured soil low in organic matter. In addition, **Moubarak (1960),** observed that colony counts of actinomycetes were markedly increased after year due to the effect of cultivation and organic manuring.

Table (11): Effect of mulch treatments on periodical changes in bacteria counts ($X10^6/g$) in soil dry weight of Anna apple trees.

Growth period	30		60		90		120		150		180	
	Days											
Treatment	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Twice clean cultivation (control)	75	80	105	110	92	100	80	96	60	66	40	48
Field crop residues mulch	120	144	158	160	215	225	376	364	200	232	160	180
Rice straw mulch	61	72	91	108	225	242	240	260	190	196	80	88

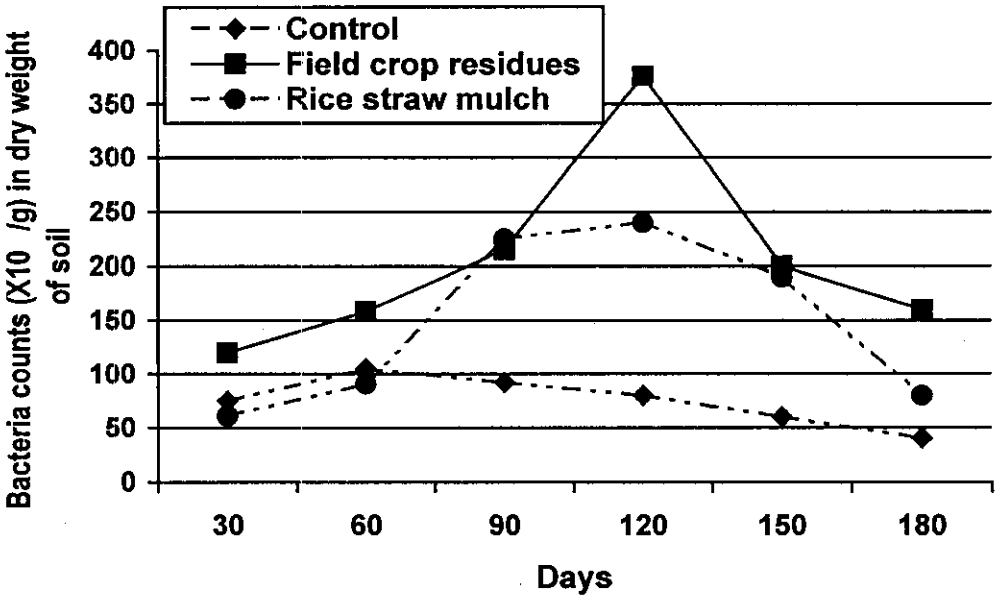

Fig. (13): Effect of mulch treatments on periodical changes in bacteria counts ($X10^6$/g) in soil dry weight of Anna apple trees (1996 season).

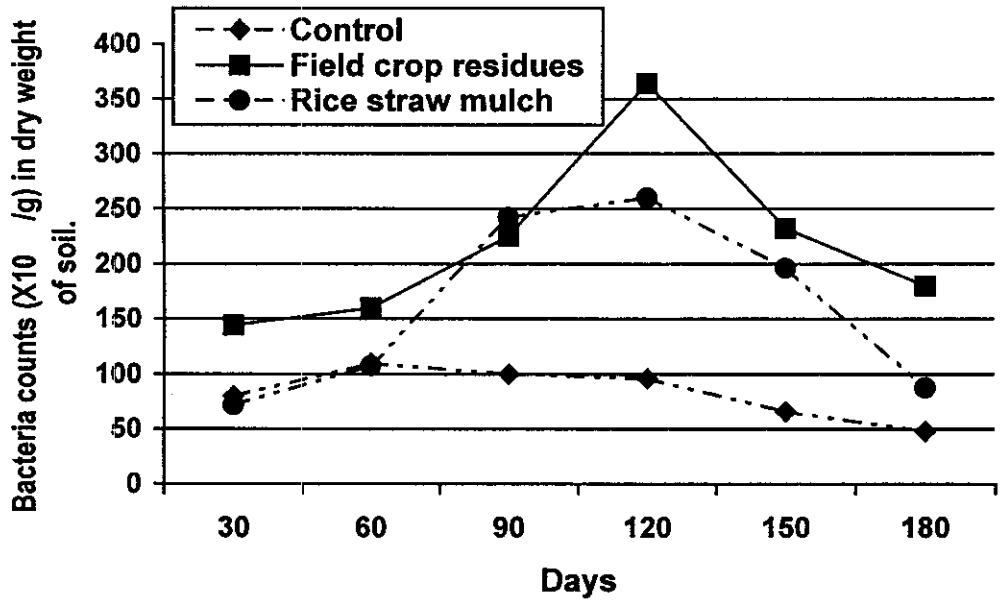

Fig. (14): Effect of mulch treatments on periodical changes in bacteria counts ($X10^6$/g) in soil dry weight of Anna apple trees (1997 season).

Table (12): Effect of mulch treatments on periodical changes in actinomycetes counts ($X10^5/g$) in soil dry weight of Anna apple trees.

Growth period	30		60		90		120		150		180	
	Days											
Treatment	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Twice clean cultivation (control)	30	36	36	44	56	60	66	72	50	56	48	52
Field crop residues mulch	88	92	146	152	158	162	190	196	120	130	100	105
Rice straw mulch	60	66	70	82	110	120	160	148	128	136	120	124

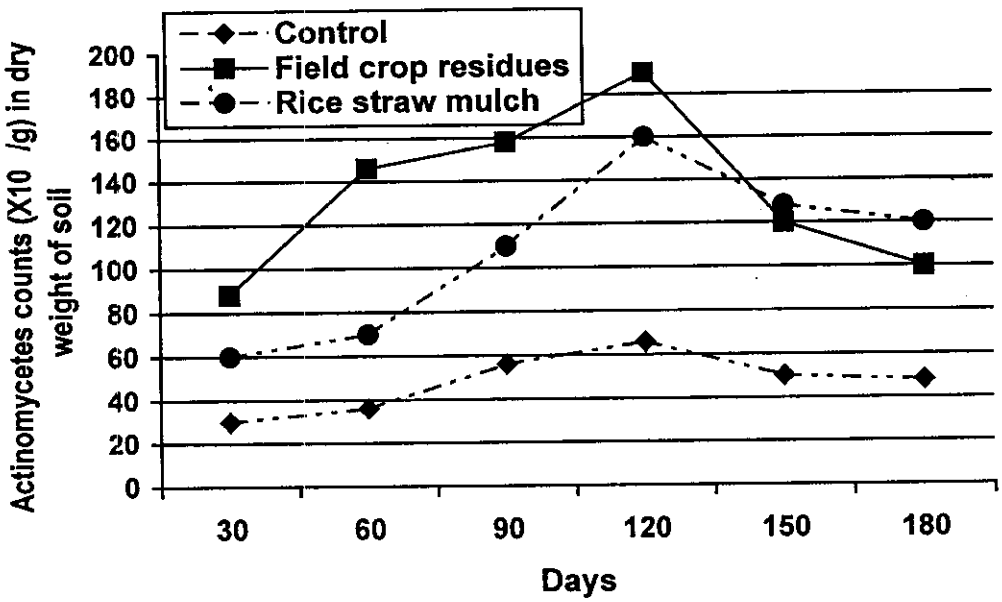

Fig. (15): Effect of mulch treatments on periodical changes in actinomycetes counts ($X10^5$/g) in soil dry weight of Anna apple trees (1996 season).

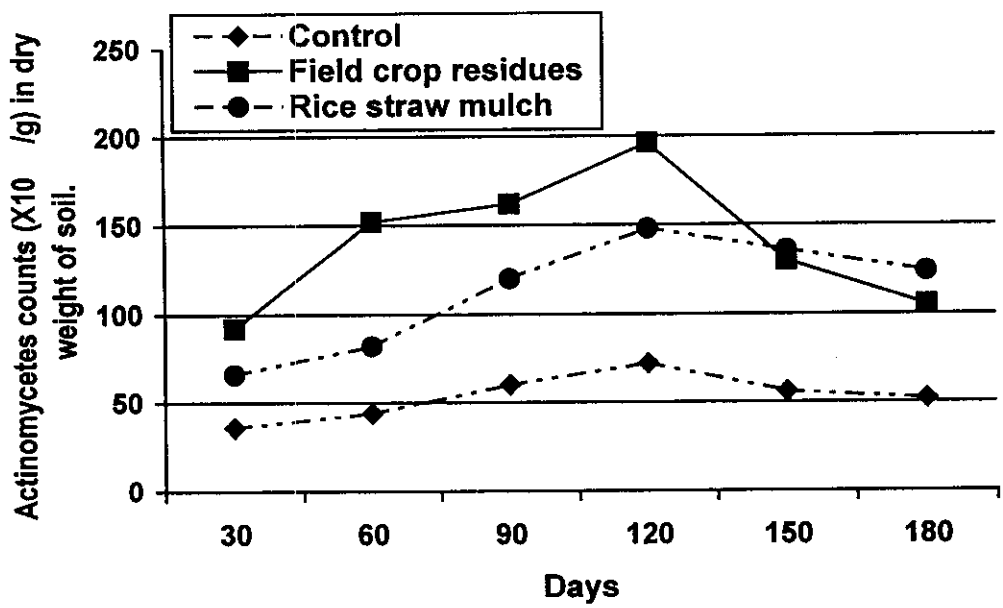

Fig. (16): Effect of mulch treatments on periodical changes in actinomycetes counts ($X10^5$/g) in soil dry weight of Anna apple trees (1997 season).

Moreover, it is quite evident from **Table (13) and Figs. (17 & 18)** that mulch treatments increased the activity of fungi microorganisms in the soil when compared with the control treatment (twice-clean cultivation). Meanwhile, rice straw mulch was more promising in increasing fungi activities than field crop residues mulch in this respect. In addition, periodical changes in fungi counts in the soil increased till 150 days then decreased afterwards. That was true in the control treatment as well as mulch treatments.

These result some what agreed with the findings of **Lockett (1937)**. He found that the count of fungi was greatly increased by the addition of clover and rye. The extent of the increase being determined by the nature of the organic material applied. In addition, **Pathak (1953 & 1954)** reported that the greatest increase in the number of fungi occurred after treating with organic manures.

Furthermore, **Table (14) and Figs. (19 & 20)** clearly, indicated that in both seasons C : N ratio in mulch sources used in this study was high during January and February then decreased gradually till June. Rice straw mulch on one hand had higher C/N ratio than the corresponding ones of field crop residues mainly during the period from April to June. Such result safely illustrate that field crop residues rapidly decomposed than rice straw mulch.

Table (13): Effect of mulch treatments on periodical changes in fungi counts ($X10^3/g$) in soil dry weight of Anna apple trees.

Growth period	30		60		90		120		150		180	
	Days											
Treatment	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Twice clean cultivation (control)	7.0	9.0	11.0	13.0	13.0	15.0	24.0	28.0	30.0	32.0	20.0	25.0
Field crop residues mulch	16.0	18.0	33.0	35.0	48.0	51.0	53.0	60.0	72.0	76.0	50.0	52.0
Rice straw mulch	19.0	22.0	28.0	30.0	66.0	69.0	70.0	72.0	80.0	84.0	40.0	42.0

Table (14): Seasonal changes in C : N ratio of mulch sources (Field crop residues and rice straw).

Treatment	Field crop residues		Rice straw	
Season	1996	1997	1996	1997
January	9.94	10.35	8.97	9.20
February	9.70	9.75	8.49	8.90
March	7.16	7.26	7.43	7.13
April	5.93	5.45	6.36	6.56
May	5.00	4.86	5.80	5.86
June	4.81	4.40	5.66	5.4

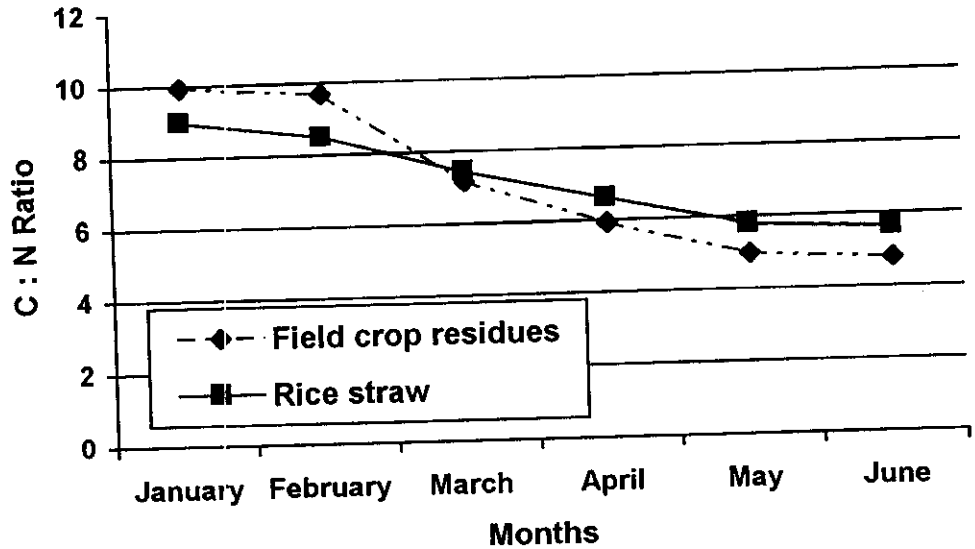

Fig. (19): Seasonal changes in C : N ratio of field crop residues and rice straw mulch (1996 season)

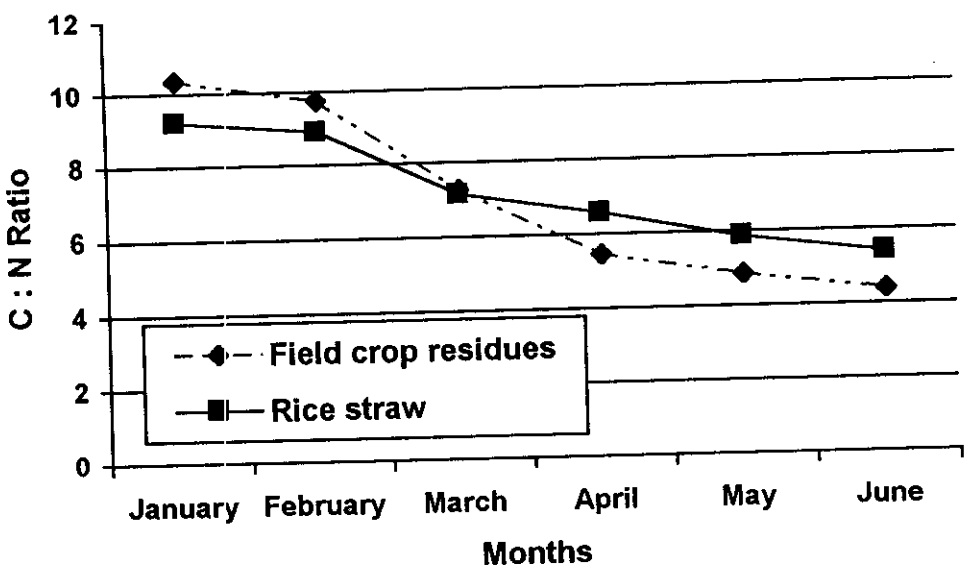

Fig. (20): Seasonal changes in C : N ratio of field crop residues and rice straw mulch (1997 season).

Thus, rice straw mulch can be applied to apple trees earlier than field crop residues.

In addition, **Voinova *et al.*, (1986)** found that mulching and green manuring had a favorable effect on the soil microflora especially cellulose decomposing microorganisms, while **He and Yu (1992)** stated that the best results were obtained with rice straw mulching in (early April, 18 Kg rice straw per tree to a depth of 15 cm), which increased the organic matter content and water holding capacity of the soil.

IV.5. Cost/benefit of different soil management systems

Table (15) and Fig. (21) clearly showed that mulch system was more profitable for Anna apple growers than the two systems of soil management used i.e. clean cultivation and herbicides since net return was highest. Meanwhile, herbicides gave higher return than clean cultivation system.

Concerning each category of soil management system, mulch sources showed that field crop residues gave highest return than rice straw. Moreover, Glyphosate herbicide surpassed the other two herbicides used in this study. On the other hand, Paraquat herbicide was inferior since it decreased net return per feddan.

Furthermore, clean cultivation treatments indicated that once clean cultivation treatment was most superior in increasing net return among the other two methods used. In addition, twice-clean cultivation treatment (control) followed once clean cultivation treatment in its net return.

These results are in general agreement with the findings of **Baxter (1970)**, which indicated that the costs of materials for strip mulching and to a lesser extent for the herbicide treated strips is justified by the increase in size and yields of young apple and peach trees. Moreover, **Egger (1989)**, stated that the cheapest method for controlling weeds flora was using simazine and Glyphosate herbicides. Besides, **Wessels (1968)**, stated that herbicides (bromacil and diuron) were estimated to be cheaper than the manual cultivation required in a normal season.

Table (15): Cost/benefit of different soil management systems of Anna apple trees.

Treatment	Price of yield (L.E.) / Fed.		Total Costs (L.E.) / Fed.		Net return (L.E.) / Fed	
	1996	1997	1996	1997	1996	1997
Twice clean cultivation (Control)	3960.96	3989.52	3080	3130	880.96	859.52
Once clean cultivation	5274.24	6480.00	3060	3100	2214.24	3380.00
No cultivation	3590.40	2900.88	3000	3000	590.40	99.12
Field crop residues mulch	8288.64	8309.52	3000	3000	5288.64	5309.52
Rice straw mulch	8236.80	8406.72	3250	3220	4986.80	5186.72
Glyphosate herbicide	7411.20	6696.00	3160	3250	4251.20	3446.00
Afalon's herbicide	4339.20	5579.28	3155	3255	1184.20	2324.28
Paraquat herbicide	3930.24	3376.08	3240	3220	690.24	156.08

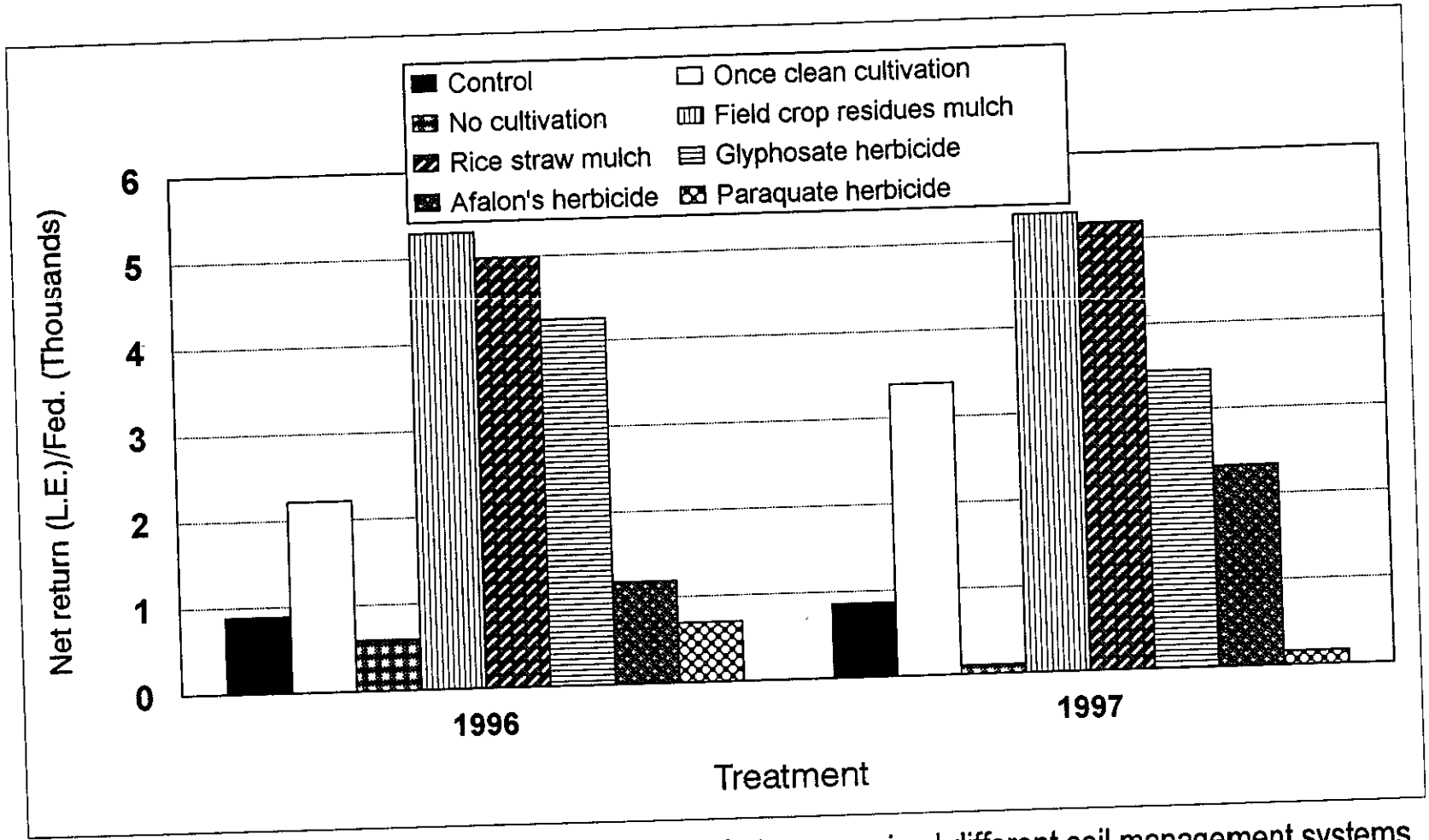

Fig. (21): Net return (L.E.) per feddan of Anna apple trees received different soil management systems.