

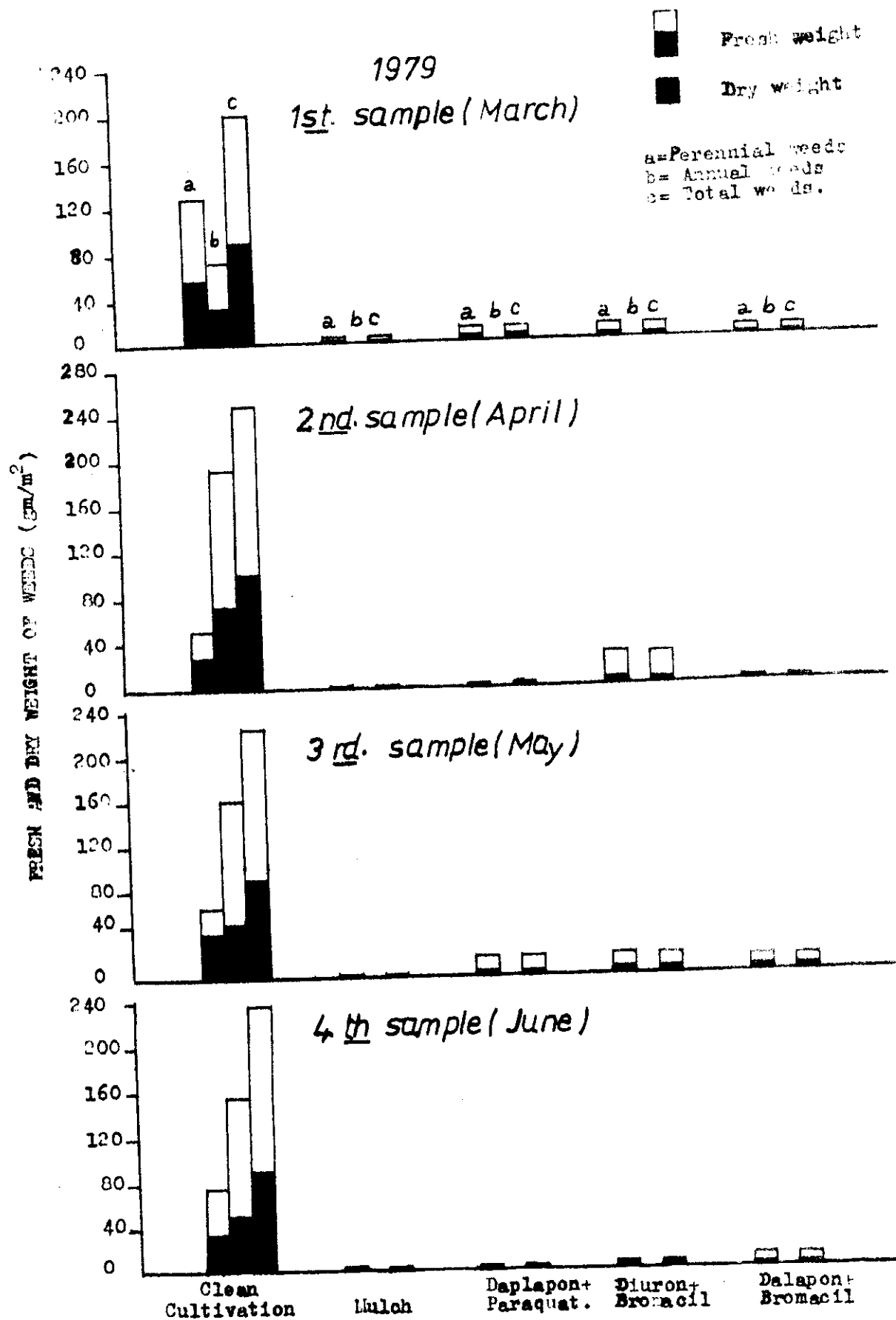
RESULTS AND DISCUSSION

A. Effect of the system of soil management on orchard weeds

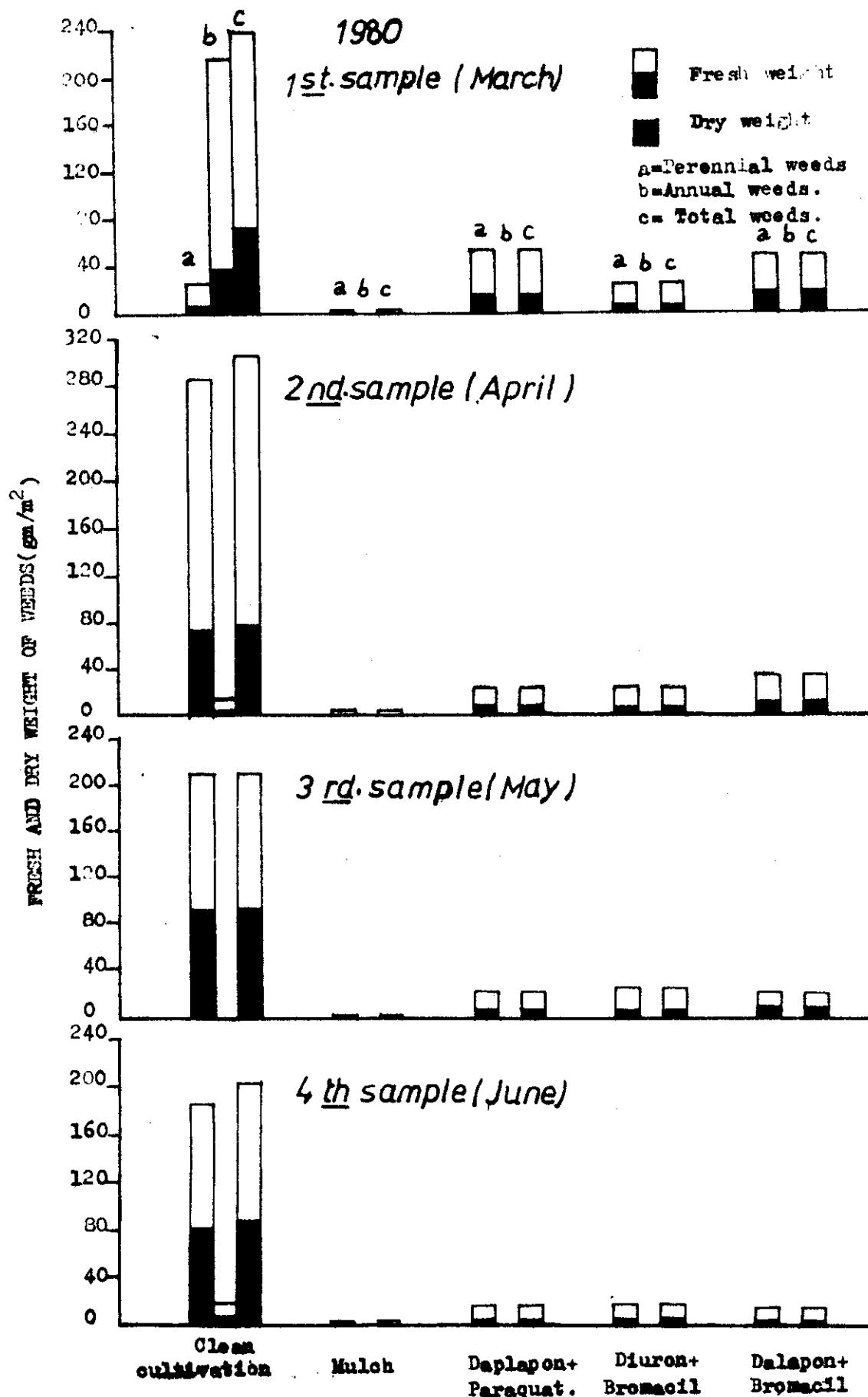
As a result of the survey for the different types of the dominant weeds and by making weed identification and classification, it was found that; prevailing weeds in the orchard were:-

- a) Annual weeds: Rabbit grass (Echinochloa colonum L.) , Soft weed (Portulaca oleracea L.) , Burr, weed (Xanthium spinosum L.) fox tail (Panicum glaucum L.) , tooth bur clover (Medicago hispida L.) . Pig weed (Amaranthus caudatus L.), Wildoats (Avena fatua L.), Sour weed (Rumex dentatus L.), and Darnel (Lolium temulentum L.)
- b) Perennial weeds: Bermuda grass (Gynodon dactylon L.) Nutgrass (Cyperus rotundus L.) , Bind weed (Convolvulus arvensis L.) and Balady short grass (Imperata cylindrica L.)

Figures (1,2) show that, satisfactory control of total weeds was achieved by rice straw mulch, followed by dalapon + paraquat, diuron + bromacil and dalapon + bromacil. Clean cultivation proved to be the least effective treatment for controlling total weeds. Rice straw mulch was superior to the traditional methods of controlling orchard weeds.



Fig(1) Effect of the system of soil management on orchard weeds



Fig(2) Effect of the system of soil management on orchard weeds

Table (2): Influence of different systems of soil management on orchard weeds

Name of weed	<u>Echinochloa</u> <u>colonum</u>	<u>Xanthium</u> <u>spinosum</u>	<u>Penicum</u> <u>claucum</u>	<u>Rumex</u> <u>dentatus</u>	<u>Cynodon</u> <u>dactylon</u>	<u>Cyperus</u> <u>rotundus</u>	<u>Convolvulus</u> <u>arvensis</u>
Treatments							
I. Clean Cultivation	+++	++	+	+	+++	+++	++
II. Rice straw mulch	--	--	-	-	---	---	+
III. Herbicides:							
a. Dalapon+							
Paraquat	--	--	-	-	+	+	+
b. Diuron+							
Bromacil	--	--	--	--	+	+	+
c. Dalapon+							
Bromacil	--	--	--	---	+	+	-

Where:

= Weeds were completely controlled.

+ few weeds showed tolerance.

++ Considerable number of weeds were still alive.

+++ Large number of weeds were still alive.

Table (2) indicates that, satisfactory and complete kill of annual weeds was achieved by mulch, dalapon + paraquat, diuron + bromacil and dalapon + bromacil, while clean cultivation showed to be the least satisfactory treatment for controlling annual weeds, since some annual weeds as Echinochloa colonum, Xanthium Spinosum, Panicum flaucum, Rumex dentatus, were observed in clean cultivation plots.

In regard to perennial weeds, table(2) shows that, excellent control was obtained by rice straw mulch, followed by dalapon + paraquat, diuron + bromacil and dalapon + bromacil. In the mean time clean cultivation failed to control noxious weeds as Cynodon dactylon, Cyperus rotundus and Convolvulus arvensis. Rice straw mulch proved to be superior in controlling all perennial weeds, except only 2 or 3 plants /plot ($50m^2$) of bind weed (Convolvulus arvensis) were observed in mulch plots. Dalapon + paraquat gave complete control of Cynodon dactylon and Cyperus rotundus, but few showed resistance, also dalapon + paraquat inhibited the growth of Convolvulus arvensis, but some bind weeds were observed in dalapon + paraquat plots.

Diuron + bromacil gave excellent control of Cynodon dactylon but few were still alive , also diuron + bromacil controlled effectively Cyperus rotundus and inhibited the growth of Convolvulus arvensis , but few renewed their growth. Dalapon + bromacil gave satisfactory control of all perennial weeds, except few weeds such as Cynodon dactylon and Cyperus rotundus showed resistance.

The results obtained for clean cultivation confirm earlier reports by Grossenbacher (1924), Simons(1958) Freshwater (1967), Torrest (1976) and Gomezde & Barreda (1977). While the efficient use of rice straw mulch as a superior method for controlling orchard weeds was reported by, Cahoon et al., (1963) Kouwenhoven (1975), Maugery (1975), Zwick (1976) and Uzrad (1978).

In the mean time the use of dalapon + paraquat as a suitable herbicide for controlling annual and noxious weeds was reported by Cucchi et al., (1963) Gorthevskij et al. (1964), Lichy & Ryan (1966) , Bos & Zavarzin (1967) Arenstein & Atzmon (1968), Spiridonov & Yakovlev (1969) Aitken (1970) , Hammetron (1971), Dokova (1972), Misra et al., (1978) and Americanos (1978).

On the other hand, bromacil + diuron were recommended as an effective herbicides for controlling most orchard weeds was stated by, Ryan (1965) , Schmitlin et al. (1967), Perugia (1967) Nanaya et al. (1975), Oren (1976), Zahnk (1976), Paresh & Misra., (1977), Ossin (1978), Brown et al., (1978) Santaballa et al., (1978) and Chitkara et al., (1979). In the mean time the results obtained for using dalapon + bromacil agree with those obtained by, lifshitz et al., (1968) Axelfed & Israely (1968), Labrada & Perez (1975), Oren (1976) Patil (1976) and mullins et al., (1978).

In general rice straw mulch proved to be the superior method in controlling all orchard weeds followed by dalapon + paraquat, diuron + bromacil and dalapon + bromacil. Clean cultivation showed to be the least satisfactory method in controlling most orchard weeds.

B. Effect of the system of soil management on vegetative growth

Table (3) shows the vegetative growth responses of "Washington" navel orange trees to the effect of the system of soil management. It is clear that, rice straw mulch resulted in highly significant increase in spring shoot length as compared to clean cultivation, dalapon+ bromacil and diuron+ bromacil and caused significant increase over dalapon+paraquat during the first season, while in the second season, rice straw mulch caused an increase in shoot length at the 1% level over all treatments. This result is in agreement with that reported by Proebsting (1958). Sitton et al. (1959), Baxter (1970), Monstra et al. (1972), Fideghelli et al. (1973), Vardaniya et al. (1976) Jazbec (1977), and Mullins et al. (1978). Dalapon +paraquat showed high significant increase in shoot length as compared to clean cultivation and significant increase over dalapon+ bromacil during the first season. The same trend was obtained during the second season, but the increase was highly significant due to dalapon+ paraquat as compared to diuron+bromacil and dalapon+bromacil. This result confirms that mentioned by Kretchman & Simanton (1959), Gortlevskij et al. (1964),

Table (3) Effect of the system of soil management on vegetative growth of "Washington" navel orange trees.

Treatments	1979* Means										1980* Means									
	(1) Mean increase in spring shoot length (mm)	(2) Growth increase in leaf No. %	Mean increase in leaf No. %	Mean increase in leaf No. %	Leaf dry weight (mg)	Leaf area (cm ²)	Leaf index L/W	Mean increase in spring shoot length (mm)	Growth increase in leaf No. %	Mean increase in leaf No. %	Mean increase in leaf No. %	Leaf dry weight (mg)	Leaf area (cm ²)	Leaf index L/W						
I. Clean Cultivation	17.70	22.32	1.00	18.07	183	16.65	2.40	16.00	31.12	0.61	14.80	159	15.30	2.42						
II. Rice straw mulch	32.70	39.72	1.42	26.43	200	18.53	2.33	26.80	40.70	1.01	20.80	195	19.27	2.39						
III. Herbicides																				
a. Dalapon+Parquat	28.10	34.21	1.27	22.51	195	15.99	2.45	23.40	33.76	0.67	16.70	162	15.10	2.45						
b. Diuron+Bromacil	24.40	30.73	1.07	21.17	193	17.42	2.32	21.00	31.86	0.61	16.80	162	17.00	2.50						
c. Dalapon+Bromacil	22.70	22.37	1.06	20.34	186	17.54	2.31	19.20	31.38	0.58	15.70	158	17.15	2.51						
L.S.D. at 5%	4.60	5.18	0.16	1.19	14.7	0.88	0.03	1.7	6.77	0.06	1.90	6.2	0.62	0.02						
at 1%	6.70	7.55	0.24	1.73	21.4	1.02	0.04	2.4	9.85	0.09	2.80	9.0	0.91	0.03						

(1) Mean increase in spring shoot length= shoot length in Dec. - shoot length in March.

(2) Growth increase percentage = $\frac{\text{Shoot length in Dec} - \text{Shoot length in March}}{\text{Shoot length in March}} \times 100$

Ryan (1967), Raese et al. (1974) Ivascenke (1974), Nanaya et al. (1975) and Robinson & O'kenedy (1978), but this result is in contrary to that mentioned by Beljaeva & Zavarzin (1967), Hertz (1972) and Nikolaeva & Shutkina (1977). Diuron + bromacil caused highly significant increase in shoot length as compared to clean cultivation in the first season, and caused highly significant increase over clean cultivation and significant increase over dalapon+bromacil in the second season. This result was reported by Vernon (1965), Day et al. (1967), Van Staaldune (1968), Ryan et al. (1968), Stanek (1976), Fontes et al. (1976) and Harvey (1977). In the mean time dalapon+bromacil showed the least increase in shoot length as compared to all treatments, but the increase was highly significant over clean cultivation during the two seasons of study. This result confirms earlier reports by Kretchman & Simanton (1959) Gortlevskij et al. (1964), Van Staaldune (1968), Tucker & Phillips (1971), Ivascenko (1974) ,

Stanek (1976), but this result is in contrary to that mentioned by Bog & Zavarzin (1967), Arnoux & Tabardel (1971), Hertz(1972) and Nikolaeva & Shutkina (1977).

Regarding growth increase percentage, it is clear that, rice straw mulch caused significant increase at the 1% level in growth increase percentage over clean cultivation, dalapon+ bromacil and diuron+bromacil, also the increase was significant as compared to dalapon+paraquat during the first season. While in the second season, rice straw mulch caused significant increase at the 5% level over the clean cultivation dalapon+ bromacil and diuron+ bromacil. This result confirms that mentioned by Proebsting (1958), Sitton et al(1959) Baxter (1970), Monstra et al(1972) Jazbec (1977) and Mullins(1978). Dalapon + paraquat and diuron + bromacil showed highly significant increase in growth increase percentage as compared to clean cultivation and dalapon+bromacil during the first season, while no appreciable increase was noticed due to these treatments during the second season. This result confirms earlier reports by Ryan (1967) and Ryan & Kretchman (1968), Van Staalduine(1968), Raese et al(1974) , Ivascenko

(1974), Stanek (1976), Fontes(1976), Harvey (1976) and Robinson & O'Kennedy (1978). Dalapon + bromacil did not show promise in this respect during the two seasons of study. This result is similar to that mentioned by Kretchman & Simanton (1959), Gortlevskij et al(1964), Saburova & Petunova (1967), Tucker & Phillips (1971), Nanaya et al(1976)and Stanek (1976).

Concerning the mean increase in leaf number, it is clear that, rice straw mulch, caused highly significant increase over all treatments except dalapon+paraquat during the first season and resulted in highly significant increase in leaf number as compared to all other treatments during the second season. This result confirms earlier reports by Proebsting (1958) Sitton et al(1959), Baxter (1970), Vardaniya& Vardaniyal. (1976) Jazbec (1977) and Chkhartishvili& Bekauri (1979). Dalapon+paraquat showed highly significant increase over clean cultivation and significant increase as compared to diuron + bromacil and dalapon+bromacil during the first season, while in the second season, dalapon+ paraquat caused significant increase at the 5% level as compared to clean cultivation and diuron+bromacil and

showed significant increase at the 1% level over dalapon+bromacil. This result confirms that reported by Ivascenko (1974) Nikolaeva & Shutkina (1977) and Robinson & O'Kennedy (1978). Diuron + bromacil and dalapon+bromacil had no effect on leaf number during the two seasons of study. This result is similar to that mentioned by Day et al., (1967) Saburova & Petunova (1967), Nanaya et al., (1976), Stanek (1976) and Oren et al., (1976)

The increase in leaf number percentage in response to rice straw mulch was significant at the 1% level over all treatments during the two seasons of study. This result confirms that mentioned by Baxter (1970), Jazbec (1977), Mullins and Chkharti-shvili & Bekauri (1979). Dalapon+paraquat, showed high significant increase in leaf number percentage as compared to clean cultivation, dalapon+bromacil and showed significant increase at the 5% level as compared to diuron+bromacil during the first season, while in the second season, dalapon+ paraquat showed significant increase at the 5% level in leaf number percentage over clean cultivation. This result is in agreement with

that reported by Ryan & Kretchman (1967), Raese et al (1974) and Ivascenko (1974). Diuron + bromacil showed highly significant increase in leaf number % over clean cultivation, during the two seasons of study this result is similar to that stated by Fontes (1976) and Harvey (1977). Dalapon + bromacil caused highly significant increase in leaf number percentage over clean cultivation in the first season, and showed no effect in the second season. This was reported earlier by Saburova & Petunova (1967) and Day et al (1967).

With respect to leaf dry weight, rice straw mulch showed significant increase at the 5% level over the clean cultivation during the first season, while in the second season the increase was highly significant as compared to all other treatments. This result confirms that mentioned by Chkhartishvili & Bekauri (1979). The other treatments, showed slight increase in leaf dry weight during the two seasons of the study. This result is in agreement with that mentioned by Beljaeva & Zavarzina (1967) and Kuzentsov

et al (1972).

Regarding leaf area, it is clear that, rice straw mulch showed highly significant increase in leaf area as compared to all other treatments during the two seasons of study . This result confirms that reported by Proebsting (1958) and Mullins et al(1978). Dalapon+paraquat, showed slight decrease in leaf area as compared to clean cultivation during the two seasons of study. This result confirms that reported by Markelova (1974). Diuron + bromacil and dalapon+ bromacil significantly increased leaf area at the 5% level over clean cultivation and showed highly significant increase over dalapon + paraquat during the first season. In the second season, diuron+bromacil and dalapon+ bromacil showed highly significant increase in leaf area as compared to clean cultivation and dalapon+paraquat. This result is similar to that mentioned by Nikolaeva & Shutkina (1977) and Harvey (1977).

With respect to leaf index, rice straw mulch caused highly significant decrease in leaf index as compared to

clean cultivation and dalapon+ paraquat, while in the second season, rice straw mulch showed the highest decrease in leaf index as compared to all treatments. The decrease in leaf index due to rice straw mulch may be attributed to uneven increase in leaf dimensions (length and width) under this treatment over clean cultivation and dalapon+paraquat treatment. Dalapon+ paraquat showed highly significant increase in leaf index as compared to all treatments during the first season and caused highly significant increase over clean cultivation and rice straw mulch. While diuron+bromacil and dalapon+bromacil showed variable effect on leaf index from season to another.

In general, the greater increase in vegetative growth as expressed in (mean increase in spring shoot length, growth increase percentage, mean increase in leaf number, increase in leaf number percentage, leaf dry weight and leaf area) during the two seasons of study due to rice straw mulch may be attributed to

several factors, the most important ones are that; rice straw mulch helps in (1) controlling all weeds which compete for water and nutrient elements, (2) providing an adequate amount of organic matter, which is considered an important source of food for tree growth and development (Kenworthy & Gilligan, 1949), (3) maintaining an adequate level of soil moisture, which is necessary for physiological process in the plant and in turn for plant growth and development. (Hilgard, 1909) and (Fortier, 1909)., (4) reducing the injury of surface feeder roots (Russel, 1938), furthermore mulched trees had more extensive root system in the 0-6" soil layer, which was better aerated and contained more exchangeable nutrients. (Sitton et al 1959).

The increase in vegetative growth due to the herbicides during the two seasons of study may be attributed to the fact that herbicides have the advantage of not injuring the shallow roots of the trees which take up water and nutrients near the soil surface, (Torrest, 1976), also herbicides have the advantage of getting rid of weed competition for water and nutrient elements which are essential for plant growth.

C. Effect of the system of soil management on leaf nutrient content.

Data presented in table (4) show the means for the leaf nutrient content of "Washington" navel orange trees as affected by the system of soil management. In general the concentrations of nutrient elements determined during the study were within the optimum ranges of concentration except potassium and iron, according to the citrus leaf analysis guide by Embleton et al (1973). Both K and Fe were in the high range of concentration during the two seasons of study. Rice straw mulch caused significant increase in leaf N content over clean cultivation during the two seasons of study, the increase was highly significant in the first season and significant at 5% level in the second season. This result confirms earlier reports by Kenworthy & Gilligan (1949), Sitton et al (1959) monstra et al (1972) and Fideghell, et al (1973). Diuron & bromacil caused significant increase in leaf N content during the first season and did not cause appreciable increase in the second season. This result confirms that mentioned by Beljaeva & Zavarzine(1967) Van Staalduine (1968), Gs. guadze et al(1970), Tucker & Phillips (1971) and Chitkara et al

(1979). In the mean time, all other treatments increased leaf N content during the two seasons of study over the clean cultivation. This result was reported earlier by Aitknson & Holloway (1967), Bos & Zavarzin (1967), Beljaeva & Zavarzine(1967) and Carlson (1968) Raese et al(1974) and Chitkara et al(1979).

Leaf P content was not affected by the different treatments during the first season of study. In the second season, also rice straw mulch showed, no effect on leaf P content, this result was reported earlier by Sitton et al (1959) and Fideghelli et al(1973). The decrease in leaf P content was highly significant as a result of dalapon+ paraquat and diuron+ bromacil applications as compared to clean cultivation. This result confirms that reported by Atkinson & Holloway (1976) Markelova (1973) and Chitkara et al(1979), but this result is in contrary to that reported by Beljaeva & Zavarzine(1967), Bos & Zavarzin (1967), Gs. guadse et al(1970) and Fideghelli et al (1970). Dalapon & bromacil had no effect on leaf P content during the two seasons of study. This result confirms earlier reports

by Beljaeva & Zavarzine(1967), Bos & Zavarzin (1967) Fideghelli et al(1973) and Chitkara et al (1979).

Leaf K content was slightly increased due to the rice straw mulch and dalapon + bromacil during the two seasons of study. This result is in agreement with that mentioned by Kenworthy & Gilligan (1949), Sittou et al (1959) Bos & Zavarzin (1967), Beljaeva & Zavarzine(1967) Gs. guadage et al(1970) and Fideghelli et al(1973). While dalapon + paraquat and diuron+ bromacil had no effect on leaf K content during the two seasons of study. Similar result was reported earlier by Atkinson & Holloway (1976) and Chitkara et al(1979)

In regard to leaf Ca content, rice straw mulch had no effect during the two seasons of study, while dalapon+ paraquat caused highly significant decrease during the two seasons of study as compared to clean cultivation, rice straw mulch and diuron+ bromacil. The decrease in leaf Ca content due to dalapon+ paraquat may be attributed to the increase in leaf Mg content. On the other hand, diuron+

bromacil showed no effect on leaf Ca content during the two seasons of study. This result confirms that mentioned by Aitkinson & Holloway (1967). In the mean time, dalapon + bromacil significantly decreased leaf Ca content as compared to clean cultivation and showed highly significant decrease in leaf Ca content as compared to rice straw mulch and diuron+bromacil during the first season. While, in the second season, dalapon+bromacil caused highly significant decrease in leaf Ca content as compared to clean cultivation, diuron+bromacil and rice straw mulch. This decrease in leaf Ca content due to dalapon+bromacil may be attributed to the increase in leaf Mg content due to this treatment.

Regarding leaf Mg content rice straw mulch showed slight increase in leaf mg content during the first season as compared to clean cultivation, however, this increase was highly significant during the second season as compared to clean cultivation, dalapon+paraquat and diuron+bromacil. This result is in agreement with that mentioned by Sitton et al (1959). Dalapon+paraquat caused significant increase in leaf mg content in the first season and had no effect during the

second season as compared to clean cultivation. This result confirms that mentioned by Atkinson & Holloway (1976) and Fideghelli et al(1973). While diuron+bromacil significantly increased leaf Mg content in the first season, and had no effect in the second season. This result is in agreement with that mentioned by Atkinson & Holloway (1976) and Fideghelli et al (1973). The application of dalapon+bromacil caused significant increase in leaf Mg content in the first season as compared to clean cultivation, and showed highly significant increase during the second season as compared to all other treatments except rice straw mulch, This result confirms that reported by Atkinson & Holloway (1976) and Fideghelli et al(1973).

With respect to leaf Fe content, rice straw mulch showed highly significant increase over clean cultivation and dalapon+ paraquat during the first season and caused significant increase over dalapon+ bromacil and insignificant increase over clean cultivation and diuron+bromacil in the second season. Dalapon+ paraquat caused slight increase in

leaf Fe content during the two seasons as compared to clean cultivation. Diuron+bromacil caused significant increase in leaf Fe content over clean cultivation during the first season and had no significant effect on leaf Fe content during the second season, the application of dalapon+bromacil caused significant increase in leaf Fe content as compared to clean cultivation and dalapon+paraquat during the first season. While in the second season, dalapon+ bromacil showed slight decrease in leaf Fe content as compared to clean cultivation.

With respect to leaf Zn content, all treatments showed no effect on leaf Zn content during the first season, while in the second season, rice straw mulch caused highly significant increase in leaf Zn content over all other treatments. Dalapon+paraquat caused high significant increase in leaf Zn content over clean cultivation, diuron+bromacil and dalapon+ bromacil, while diuron+bromacil caused slight increase in leaf zinc content. In the mean time, dalapon+ bromacil caused slight decrease in leaf Zn content during the two seasons of study as compared to all other treatments.

Concerning leaf Mn content, all treatments caused highly significant increase in leaf Mn content as compared to clean cultivation during the first season, while in the second season rice straw mulch, diuron+bromacil and dalapon+bromacil slightly increased leaf Mn content whereas dalapon+paraquat significantly increased leaf Mn content over the clean cultivation. The results obtained for (Fe,Zn,Mn) are in agreement with that mentioned by Kenworthy & Holloway (1949), Atkinson & Holloway (1976) and Fideghelli et al (1973).

From the results obtained for the first two seasons of this study, it is clear that no definite trend could be drawn regarding the effect of the system of soil management on leaf nutrient content of "Washington" navel orange. It should require several years before soil physical and chemical factors could settle and root distribution could shape a new form in response to different systems of soil management, therefore, the data obtained would only show the preliminary impact of the treatments on leaf nutrient content that may be subject to change in later years.

D. Effect of the system of soil management on tree fruiting

1. Fruit set

Fruit set of "Washington" navel orange trees in response to the system of soil management is presented in table (5). It is clear that, the highest percentage of fruit set was obtained by rice straw mulch, as compared to all other treatments. Diuron + bromacil was next to mulching in increasing the percentage of fruit set, followed by dalapon + paraquat, then dalapon+bromacil, during the (1979) season. The trend was similar in this respect during the (1980) season. The highest percentage of fruit set was obtained by mulching with rice straw as compared to all other treatments. However dalapon + paraquat was next to mulching in increasing the percentage of fruit set, followed by diuron+bromacil then dalapon+bromacil as compared to clean cultivation "control". On the other hand, dalapon+bromacil caused the least increase in fruit set percentage over clean cultivation as compared to all other treatments, but the increase was significant at the 5% level. A number of contributing factors may explain the obtained significant increase in fruit set under different treatments over the clean cultivation, but more prominent ones are those related to (1) better weed control under these treatments

Table (5) Effect of the system of soil management on fruit set percentage of "Washington" navel orange trees

Treatments	Fruit set percentage ⁽¹⁾	
	1979	1980
I. Clean cultivation "Control"	13.47	12.10
II. Rice straw mulch	18.78	19.21
III. Herbicides		
a. Dalapon+Paraquat	15.96	16.64
b. Diuron+Bromacil	17.02	15.18
c. Dalapon+Bromacil	14.20	13.48
L.S.D. at 5%	0.46	0.98
at 1%	0.67	1.42

(1) Fruit set % = $\frac{\text{No. of developing fruitlets after petal fall}}{\text{Total No. of flowers at full bloom.}} \times 100$

resulting in reduced competition for available water and nutrient elements. (2) repeated injury of the surface feeder roots under clean cultivation reduces the efficiency of root system for absorption specially under conditions of stress and (3) the rice straw mulch had an added advantage of conserving soil moisture, preventing large fluctuations in soil moisture and increasing soil organic matter thus providing better environment for feeder roots growth and absorption (Maugerj & Giudice, 1975).

2. Fruit drop

Fig(3,4) show the percentages of fruit drop at intervals from April 2nd till June 21th of "Washington" navel orange trees as influenced by the system of soil management. It is clear that, rice straw mulch decreased fruit drop percentages during the period from April 2nd till May 2nd and the period from May 23th till June 21th). Dalapon+paraquat was next to rice straw mulch in decreasing the percentage of fruit drop, followed by diuron+ bromacil. The least satisfactory treatment in decreasing the percentage of fruit drop was obtained from dalapon+bromacil treatment.

The effect of rice straw mulch in decreasing fruit drop percentages may be attributed to the fact that rice straw mulch increased the capacity of the soil for conserving soil moisture and got rid of weeds which compete with trees for water, in the mean time reduce the injury to the roots which take up water, all these together helped to maintain the trees about suitable water balance and thus reducing fruit drop percentages. On the other hand herbicides gave good control for weeds which compete for water and decreased

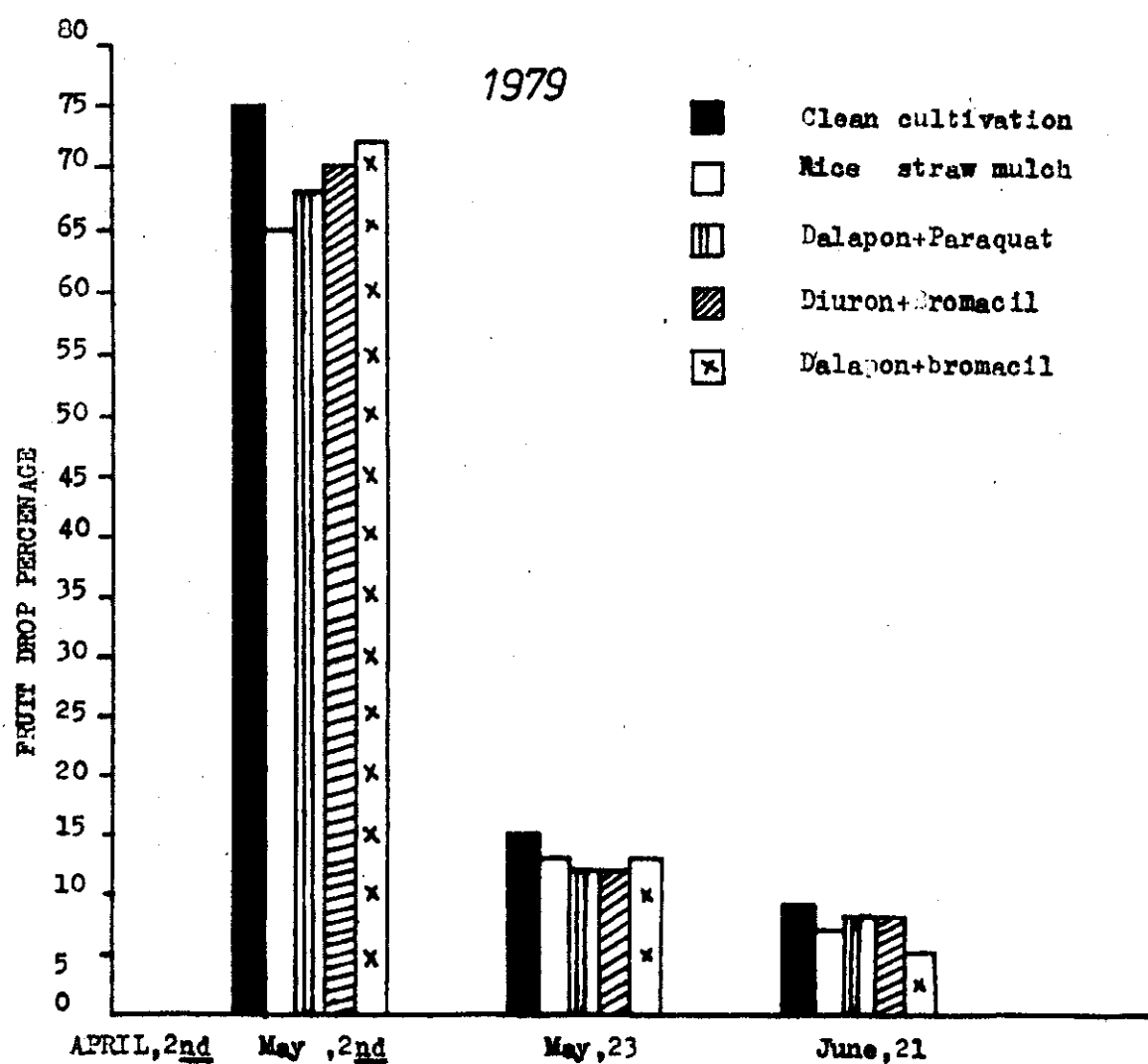


Fig.(3) Effect of the system of soil management
on shedding of young Washington navel fruits

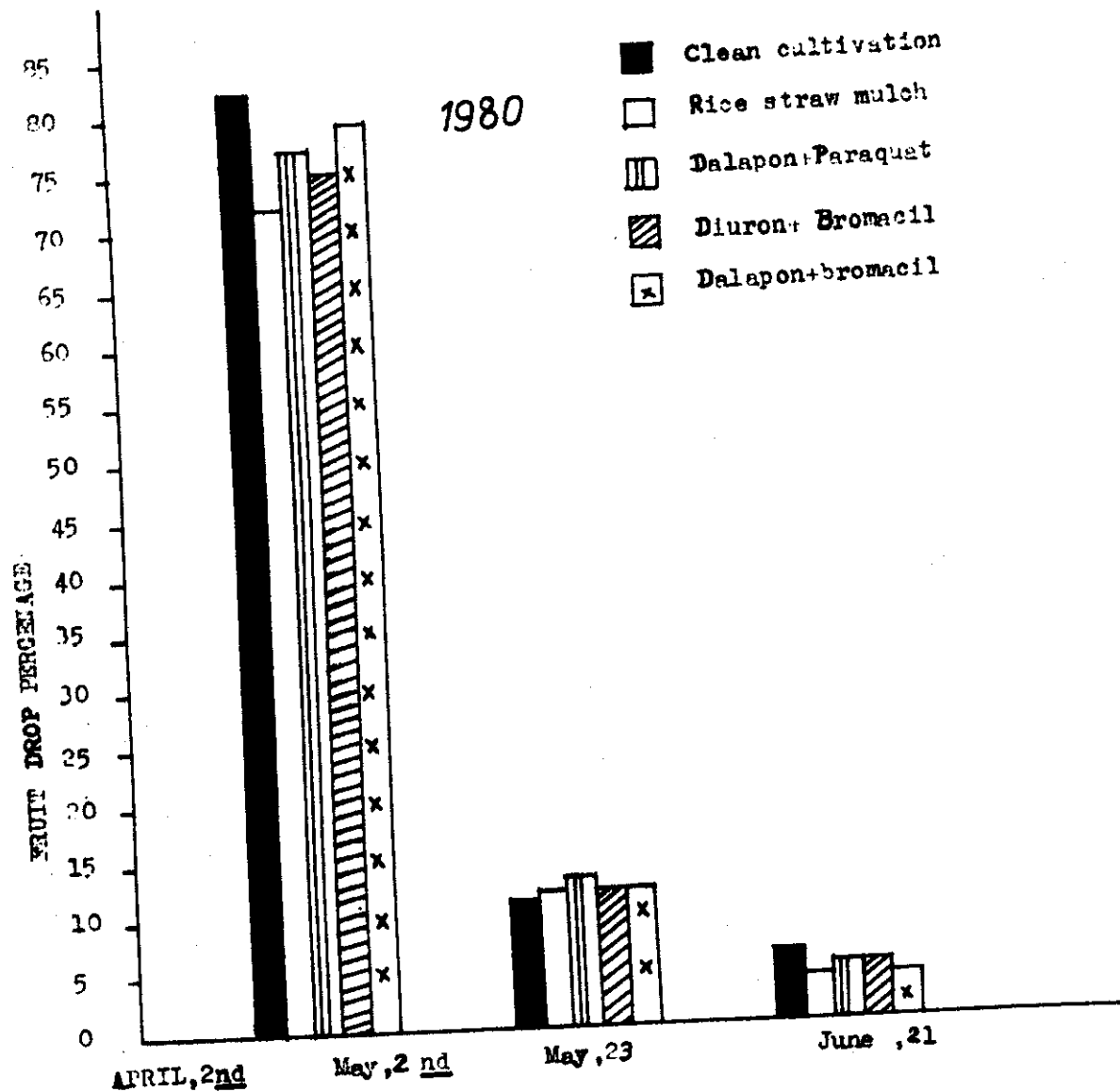


Fig. (4) Effect of the system of soil management
on shedding of young Washington navel fruits

root injury which absorb the water, all these together helped in reducing fruit drop percentages through maintaining good water balance mainly during periods of hot dry winds in April and May.

3. Yield

Data concerning the yield as kilograms per tree for the two seasons 1979 and 1980 are shown in table (6). It is clear that in 1979 season(considered as an off-year), all treatments resulted in an increase in yield over clean cultivation. This increase was significant (at the 1% level) with rice straw mulch treatment, which gave the highest increase in yield, the increase reached about (11 Kg) over the control (approximately 44.5% increase). The increase in yield was also significant (at the 5% level) with dalapon+paraquat and diuron+bromacil which were (about 28.77%, 21.91% over clean cultivation respectively). The application of dalapon+ bromacil did not show promise in the 1979 season.

Table (6): Effect of the system of soil management on yield, fruit number, fruit weight and biennial bearing index of "Washington" navel orange trees.

Treatments	"1979 means"			"1980 means"			Biennial bearing index (1)
	Yield as Kg/tree	Yield as No of fruit/tree	Fruit weight "gm"	Yield as Kg/tree	Yield as No of fruit/tree	Fruit weight "gm"	
I- Clean cultivation	24.33	77	314	51.83	233	221	36.10%
II-Rice straw mulch	35.16	94	369	69.66	315	220	32.91%
III.Herbicides							
a. Dalapon+Paraquat	31.33	98	322	65.33	293	223	35.17%
b. Diuron+Bromacil	29.66	94	314	66.00	309	213	37.98
c. Dalapon+ Bromacil	24.50	74	331	59.66	256	225	41.77
L.S.D. at 5%	5.28	17.0	34.59	3.67	29.20	23.42	----
at 1%	7.68	26.1	50.32	5.34	42.49	34.08	----

$$(1) \text{ Biennial bearing index} = \frac{\text{Difference between successive yields}}{\text{Sum of successive yields}} \times 100$$

All treatments also caused an increase in yield during 1980 season (though it was considered to be an on-year) the increase was highly significant in all treatments. The highest increase was noticed in rice straw mulch which gave about (18 Kg) per tree over clean cultivation (approximately 34.40% increase). This result is in agreement with that reported by Proebsting (1958) Sitton et al (1959), Baxter (1970), Monstra et al (1972) Fideghelli et al (1973), Jazbec (1977) and Chkhartishvili & Bekauri (1979), also dalapon + paraquat caused highly significant increase in yield which was (about 26% over control). This result confirms that mentioned by Ryan et al (1967), Robinson & Singh (1973), Raese et al. (1974) and Americanas (1978), in the mean time diuron + bromacil resulted in highly significant increase, which represents (about 27% over clean cultivation). This result is in agreement with that mentioned by Wessels (1968), Ryan et al (1968), Tucker & Phillips (1971), Brown & Constantin (1972), Harvey (1977) and Chitkara et al (1979). Dalapon + bromacil caused significant increase over clean cultivation which represents (11% increase). This result is

in agreement with that reported by Cucchi et al. (1963) ,
Saburova & Petunova (1967), Tucker & Phillips (1971),
Robinson & O'Kennedy (1978) and Schroder et al. (1978).

The increase in the yield due to the different treatments
may be attributed to the fact that, the trees in the treated
plots are in good state of growth with sufficient amount
of available nutrients and adequate level of soil moisture
(mainly in rice straw treated plots), all these together
resulted in increasing the percentage of Fruit set and
decreasing the percentage of fruit drop and the final
gain is the high yield in the treated plots over untreated
ones.

Concerning the yield as number of fruits per tree,
it is clear that, dalapon + paraquat, rice straw mulch
and diurnan + bromacil resulted in a significant increase
over the clean cultivation (at the 5% level) in the first
season. For the season (1980), highly significant increase
in fruit number per tree was recorded due to rice straw
mulch. This finding confirms that reported earlier by

Baxter (1970), Jazbec (1979), Mullins et al. (1978) and Chkartistavili & Bekauri (1979). Dalapon+ paraquat resulted in a significant increase in fruit number. This finding confirms that reported by Ryan et al.(1968), Robinson & Singh (1973) and Raese et al.(1974). In the mean time diuron + bromacil resulted in an increase in fruit number at the 5% level over the clean cultivation. This result is in agreement with that reported by Ryan et al.(1968), Wessels (1968), Brown & Constantin (1972) Harvey (1977) and Chitkara et al.(1978). Dalapon + bromacil slightly increased fruit number. This result confirms that reported by Ryan et al.(1968) and Schroder (1978). The increase in fruit number per tree due to the different treatments is greatly correlated to the increase in fruit set percentage and to the decrease in fruitlet drop in the treated plots as compared to clean cultivation.

In regard to fruit weight, it was obvious that rice straw mulch resulted in highly significant increase

in fruit weight in the first season, while no appreciable increase was noticed in the second season. This result is in agreement with that mentioned by Baxter (1970). The increase in fruit weight due to rice straw may be attributed to the increase in nitrogen and in the mean time the increase of soil moisture due to rice straw contributed to large extent in increasing fruit weight. (Anderssen, 1937). The other treatments did not affect fruit weight during the study. These findings confirm earlier reports by Carlson (1968), Cyperus. A.R.I. (1969), Brown & Constantin (1972) and Hilkenbaumer & Kolbe (1974).

It is dear that, rice straw mulch showed the least decrease in biennial bearing index (32.91%) followed by dalapon + paraquat (35.171), then clean cultivation (36.10%). While diuron+bromacil caused an increase in biennial bearing index, in the mean time, the highest increase of biennial index was obtained from dalapon+bromacil.

E. Effect of the system of soil management on fruit quality

Table (7-a) shows the physical characteristics of "Washington" navel oranges as affected by the system of soil management during 1979 and 1980 seasons. Fruit volume was significantly increased due to rice straw mulch during the two seasons of study. This result in agreement with that reported by Baxter (1970). The increase in fruit volume due to rice straw mulch may be attributed to the increase of nitrogen, and increasing the soil moisture content under mulched trees and possibly one factor here is the movement of nitrates from the surface soil into the root zone since very small oranges have been associated with a lack of both moisture and nitrate in the root zone of the trees (Batchelor, 1933). Dalapon+ bromacil caused significant increase in fruit volume in the first season but with no appreciable increase in the second season, this result confirm that reported by Cyprus A.R.I. (1969) and Brown & Constantin (1972). The other treatments did not affect fruit volume during the study. This finding is reported by Carlson (1968), Cyprus A.R.I. (1969), Brown & constantin (1972) and Hilkenbaumer & Kolbe (1974).

Table (7-a) Effect of the system of soil management on the Physical properties of "Washington" navel orange fruits

Treatments	"1979 means										"1980" Means									
	fruit volume (cm ³)	fruit height (cm)	fruit diameter (cm)	fruit index (h/d)	Peel thickness (mm)	Juice weight/ fruit (gm)	Juice volume/ fruit (cm ³)	Juice %	fruit volume (cm ³)	fruit height (cm)	fruit diameter (cm)	fruit index (h/d)	Peel thickness (mm)	Juice weight/ fruit (gm)	Juice volume/ fruit (cm ³)	Juice %				
Clean cultivation	378	8.7	8.4	1.04	6.0	107	105	31.42	254	7.7	7.5	1.02	5.4	92	86	39				
Rice straw mulch	419	9.1	8.8	1.04	6.8	107	102	27.84	298	8.3	7.9	1.03	6.4	99	97	35				
Herbicides:																				
Dalapon+Paraquat	372	8.5	8.4	1.01	6.3	104	102	32.50	253	7.4	7.4	0.99	5.8	88	87	39				
Difuron+Bromacil	377	8.8	8.5	1.04	6.2	98	101	29.20	255	7.7	7.4	1.03	5.7	88	86	38				
Dalapon+Bromacil	412	8.8	8.5	1.03	6.1	104	102	29.40	256	7.7	7.5	1.03	5.6	92	86	39				
LSD. at 5%	32.97	0.13	0.14	0.02	0.26	5.65	5.34	2.52	13.20	0.31	0.175	0.03	0.36	3.28	1.88	205				
at 1%	47.97	0.19	0.20	0.03	0.38	8.22	7.77	3.67	19.21	0.45	0.225	0.05	0.53	4.77	2.73	2.99				

Fruit height was highly increased by mulch during the two seasons. This result is in agreement with that reported by Baxter (1970) and Hilkenbaumer & Kolbe (1974). Dalapon+ paraquat significantly decreased fruit height during the two seasons, on the other hand, fruit height was not affected by other treatments during the two seasons, this findings confirm that reported by Baxter (1970), Tucker & Phillips (1971), Hilkenbaumer & Kolbe (1974) and Zaki (1979). Rice straw mulch caused highly significant increase in fruit diameter during the two seasons of study, this result is in agreement with that mentioned by Baxter (1970) and Hilkenbaumer & Kolbe (1974). In the mean time, all other treatments had no obscure effect on fruit diameter during the two seasons of study, this result is in agreement with that reported by Patt (1956) Carlson (1968) and Zaki (1979). Fruit index was significantly decreased by dalapon+ paraquat during the two seasons and was not affected by other treatments during the study. This findings confirm that reported by Carlson (1968) and Zaki (1979).

Concerning the effect of different treatments on peel thickness, it is clear that, rice straw mulch caused highly significant increase in peel thickness over the control during the study, also dalapon+paraquat significantly increased fruit peel thickness during the two seasons. This result is in agreement with that reported by Beljaeva & Zavarzine (1967). The increase in peel thickness due to rice straw mulch and dalapon+paraquat may be attributed to several factors, but more prominent ones are that, these two treatments resulted in increasing N uptake which resulted in a thicker skinned fruit (Martin, 1942, and slightly decreased P uptake and slightly increased K uptake which were correlated with a thick rind (Andreseen, 1937). The other treatments had no effect on peel thickness during the two seasons of study. This is in agreement with that mentioned by Jordan (1960) and Zaki (1979).

It is noticed that diuron+bromacil significantly decreased Juice weight during the two seasons. This result is in agreement with that reported by Zaki (1979). rice straw mulch had no significant effect on juice weight

in the first season and significantly increased juice weight in the second season, in the mean time dalapon+paraquat slightly decreased juice weight in the first season, but the decrease was significant in the second season. Diuron+bromacil significantly decreased juice weight during the two seasons of the study. These results are in agreement with that reported by Zaki (1979). Dalapon+bromacil did not show much effect during the two seasons. This result confirm that reported by Carlson (1968), Tucker & Phillips (1971) and Zaki (1979). Juice volume was slightly decreased by the different treatments during the first season, while in the second season only rice straw mulch resulted in highly significant increase in juice volume. This result is in agreement with that mentioned by Beljaeva & Zavarzine (1967) Carlson (1968) and Zaki (1979).

In regard to juice percentage, it is obvious that rice straw mulch significantly decreased juice percentage during the two seasons, while other treatments slightly decreased juice percentage during the first season and had no effect on juice percentage during the second season. This result confirm that reported by Jordan (1960) Beljaeva & Zavarzine (1967) and Zaki (1979).

Table (7-b) shows the effect of the system of soil management on the chemical characteristics of Washington navel oranges during the two seasons 1979 and 1980. All treatments had no significant effect on T.S.S. during the two seasons of study, except rice straw mulch and dalapon+bromacil which showed significant decrease in T.S.S. in the first season. This result is in agreement with that reported by Jordan (1960), Gortevskij et al(1964), Beljaeva & Zavarzine (1967), Tucker & Phillips (1971), Brown & Constantin (1972), Parekh & Misra (1977) and Zaki (1979). Acidity and T.S.S./Acid ratio were not affected by the different treatments during the two seasons of the study. These findings are in agreement with that reported by Jordan (1960), Beljaeva & Zavarzine (1967) Hilkenbaumer & Kolbe (1974), Parekh & Misra (1977) and Zaki (1979), but in contrary to that reported by Belobrov & Yanchik (1976). Concerning the effect of the different treatments on ascorbic acid, it is clear that rice straw mulch, dalapon+paraquat and diuron+bromacil showed significant decrease in ascorbic acid

Table (7-b) Effect of the system of soil management on the chemical properties of Washington navel orange fruits.

Treatments	"1979 Means				"1980" means			
	T.S.S %	Total acidity mg/100ml	T.S.S/ acid ratio	ascorbic acid mg/100ml	T.S.S %	Total acidity mg/100ml	T.S.S/ acid mg/100ml	ascorbic acid mg/100ml
I-Clean cultivation	10.9	0.72	15.0	48	11.4	0.86	13.4	44
II-Rice straw mulch	10.5	0.73	14.3	46	11.5	0.84	13.7	43
III-Herbicides:								
a-Dalapon+Paraquat	10.9	0.72	15.2	46	11.7	0.83	14.0	43
b-Diuron+Bromacil	11.0	0.73	15.0	46	11.7	0.87	13.6	43
c-Dalapon+Bromacil	10.6	0.73	14.6	47	11.4	0.85	13.6	44
L.S.D. at 5%	0.30	0.08	1.14	1.8	0.46	0.07	0.73	1.9
at 1%	0.45	0.13	1.65	2.6	0.67	0.09	1.07	2.8

as compared to clean cultivation in the first season, while dalapon + bromacil had no effect on ascorbic acid during the same season. In the second season, ascorbic acid showed slight decrease due to the different treatments except dalapon + bromacil which showed no effect. This result confirms earlier reports by khubutiya & Gogoberidze (1967), Beljaeva & Zavarzine (1967), Belobrov & Yanchik (1976) and Zaki (1979). The decrease in ascorbic acid due to the different treatments as compared to clean cultivation may be attributed to the increase of N content in the treated plots over clean cultivation, this was reported by Jones et al (1924) , who showed a relatively high negative correlation between the nitrogen and ascorbic acid content of the juice of the grapefruit, it was concluded that, the fruits from trees with a low N content produced fruits with 20 to 25 percent more vitamin C than fruits from trees of a high nitrogen content.

Table (6) : Comparison between the costs of the different system of soil management for one feddan.

Treatment Year	Clean cultivation	Mulching (Rice straw)	Dalapon+Paraquat	Diuron+Bromacil	Dalapon+Bromacil
First year	(105) Egyptian pounds. Assuming the first cultivation costs 45 Egyptian pounds, while each of the 2nd and 3rd cultivation cost 30 pounds.	(32) Egyptian pounds price of 4 tons of Rice straw mulch and labour for covering the soil.	(22) Egyptian pounds. Price of 3Kg of dalapon+ 3l of paraquat and costs of motor and spraying operation.	(28) Egyptian pounds Price of 3Kg of bromacil+1Kg of diuron and costs of motor and spraying operation.	(25) Egyptian pounds Price of 3Kg of dalapon and 2Kg of bromacil, and costs of motor and spray operation.
Second year	(105) Egyptian pounds	(16) Egyptian pounds To cover only the spots in which mulch was reduced in its thickness	(15) Egyptian pounds To spray only the infested spots.	(18) Egyptian pounds To spray only the infested spots	(16) Egyptian pounds To spray only the infested spots.
Third year	(105) Egyptian pounds	(12) Egyptian pounds covering only the bare spots.	(15) Egyptian pounds Spraying only the infested spots.	(15) Egyptian pounds Spraying only the infested spots.	(16) Egyptian pounds Spraying only the infested spots.

* Assuming that labour cost is fixed at the 1960 level.

SUMMARY AND CONCLUSION

Clean cultivation and soil management practices in fruit orchards is considered the most expensive fruit production practice owing to the continuous increase in labour cost and the primitive methods applied. It is now recognized that the efficiency of clean cultivation in controlling weeds and maintaining soil moisture and fertility is not sufficiently enough to justify the costs of these operations.

Since navel orange trees suffer in many years excessive fruitlet drop, owing to the sensitivity of these trees to environmental stresses (particularly water stress) during the critical periods of young fruit development. Therefore any cultural operation that can maintain a favourable tree water balance may help in reducing the severity of fruitlet drops, and may contribute to higher yields. It is believed that the development of a suitable system of soil management can be beneficial in this respect. This investigation was undertaken to study the effect of the system of soil management on weed control, vegetative growth, leaf nutrient content, fruit set, fruit drop and yield as well as the fruit quality of Washington navel orange trees. Fifty trees nearly similar in their growth vigour were devoted for this study. Each treatment was represented by ten trees. These treatments included:

- 1) Clean cultivation " control": carried out three times throughout the year by hand hoeing.
- 2) Mulch treatment the soil under the trees was kept covered the whole year with rice straw mulch to the thickness of about 10-15 cm.

3. Herbicidal application : The first herbicide treatments were applied in early February within the specified plots.

a. Dalapon "Dowpon "S"+ Paraquat" Gramoxone": paraquat at 1.5 L/ feddan in 100 L, followed by dalapon at 3 Kg/feddan in 300L sprayed on the renewed weeds and after that with 10 days an additional spray of dalapon at 3 Kg in 300 L took place. Only one spray was used during the whole season.

b. Bromacil " Hyvar'x + Diuron " Karmex". bromacil at 3 Kg+ diuron at 1 Kg in 600 L/feddan were sprayed on the growing weeds. Only one spray was used during the whole growing season.

c. Dalapon" Dowpon's"+ Bromacil" Hyvar'x": dalapon at 3 Kg/ feddan in 300 L, followed by bromacil at 2 Kg/feddan in 400 L, in a sequential application after 15 days. Only one spray was used during the growing season. Treatments started February 1978. Data were obtained during 1979 and 1980.

The results could be summarized as follow:

A. Weeds

Annual weeds were completely controlled by, rice straw mulch, and herbicide treatments, while clean

cultivation showed to be the least satisfactory treatment for controlling annual weeds. Rice straw mulch was superior in controlling all perennial weeds. (Only 2-3 plants of Convolvulus arvensis were observed in each mulched plot). Dalapon + paraquat was next to rice straw mulch in controlling all perennial weeds. Only few plants of Convolvulus arvensis, Cynodon dactylon and Cyperus rotundus were observed in the treated plots. Diuron + bromacil gave satisfactory control of all perennial weeds except few spots covered with few plants of Cynodon dactylon; Cyperus rotundus. Dalapon + bromacil gave a suitable control of all perennial weeds, but, few weeds of Cynodon dactylon and Cyperus rotundus were still alive.

B. Tree growth

Rice straw mulch caused the largest increase in non fruiting spring shoot length, growth increase percentage, number of leaves per shoot, increase in leaf number percentage, leaf dry weight and leaf area, but leaf index was decreased by mulching with rice straw as compared to other treatments. In the mean time dalapon + paraquat caused an increase in both, non fruiting spring shoot length, growth

increases percentage, number of leaves per shoot, increase in leaf number percentage as well as the leaf index, in the mean time, this treatment had no effect on leaf dry weight and slightly decreased leaf area. Diuron+bromacil, was next to dalapon+ paraquat in increasing non-fruiting spring shoot length, growth increase percentage, increase in leaf number percentage as well as leaf area. The treatment did not affect the number of leaves per shoot and leaf dry weight, and had variable effect on leaf index. Dalapon+ bromacil showed the least increase in vegetative growth over clean cultivation as compared to other treatments. This treatment caused an increase in non-fruiting shoot length, and leaf area and had no effect on growth increase percentage, number of leaves per shoot, increase in leaf number percentage and leaf dry weight. The treatment showed decrease in leaf index.

C. Leaf nutrient contents

Rice straw mulch increased both leaf N and Mg contents and had no effect on leaf P content and caused slight increase in leaf (K, Fe, Mn and Zn) contents. Leaf Ca content did not show a definite trend during the study. Dalapon+ paraquat, increased leaf Mn content and showed slight increase in leaf (N, K, Fe and Zn) contents, but decreased leaf

Ca content and had no definite trend on leaf P and Mg contents during the study. Diuron + bromacil had no effect on leaf (K, Ca, Zn and Fe) contents. The treatment showed slight increase in leaf (N, Mg and Mn) contents and caused slight decrease in leaf P content during the study. Dalapon+ bromacil increased leaf Mg content, caused slight increase in leaf (N, K and Mn) contents and had no effect on leaf (P) content. and showed decrease in leaf (Ca and Zn) contents. The effect of dalapon+ bromacil on leaf (Fe) content did not show definite trend.

D. Fruiting

1. Fruitset

Rice straw mulch caused the highest increase in fruit set as compared to all other treatments, followed by dalapon + paraquat and diuron + bromacil treatments, which showed nearly the same increase in fruit set, while dalapon+ bromacil showed the least increase in fruit set as compared to the other treatments, but the increase in fruit set due to dalapon+ bromacil was higher than clean cultivation.

2. Fruit drop

Rice straw mulch caused the highest decrease in fruit drop percentages, followed by dalapon+ paraquat and

diuron + bromacil, the least satisfactory decrease in fruit drop was obtained from dalapon + bromacil as compared to other treatments, but over clean cultivation.

3. Fruit yield

All treatments increased the yield as kilograms pertree. Rice straw mulch caused the highest increase in the yield followed by dalapon+ paraquat and diuron + bromacil, while the least increase in fruit yield as kilogram pertree was resulted from dalapon + bromacil application. Yield as number of fruit pertree was highly increased by rice straw mulch, followed by dalapon+ paraquat and diuron+bromacil, while dalapon + bromacil had no great effect on fruit number per tree. Individual fruit weight was correlated with the amount of the yield.

E. Fruit quality.

1. Fruit physical properties

Fruit volume and fruit dimensions were correlated to the amount of the yield.

"Peel thickness was greatly increased by rice straw mulch, also dalapon+ paraquat showed an increase in peel thickness. While other treatments had no effect on peel thickness Diuron + bromacil decreased juice weight, while

rice straw mulch showed an increase in juice weight in the second season, but , dalapon+ paraquat decreased fruit weight in the second season. Dalapon + bromacil had no effect on juice weight. All treatments had no effect on juice volume, except rice straw mulch which showed an increase in juice volume in the second season all treatments had no effect on fruit juice percentage, only rice straw mulch decreased fruit juice percentage.

2. Fruit chemical characteristics

All treatments had no effect on total fruit acidity and T.S.S./acid ratio. In the mean time juice ascorbic acid content significantly decreased in the first season and showed slight decrease in the second season due to rice straw mulch, dalapon+ paraquat and diuron+bromacil application while dalapon+ bromacil had no effect on juice ascorbic acid content. Rice straw mulch and dalapon+ bromacil showed significant decrease in T.S.S. in the first season and had no effect in the second season. Diuron + bromacil had no effect on T.S.S.

E. Costs of the different systems of soil management

It is noticed from the study that clean cultivation is considered the most expensive weed control treatment either in short or long term, while dalapon+paraquat was the least expensive treatment followed by mulching with rice straw, then diuron+bromacil. In the mean time dalapon+ bromacil treatment showed to be the most expensive chemical weed control treatment. The initial costs of rice straw mulch was relatively expensive, but in long term, the costs should be low and could be offset by the advantages in tree growth and yield.