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Yield And Quality Of Squash cv. "Victoria" As Affected By Mulches In Presence Of Watermelon Mosaic Virus -2 (WMV-2)

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ABSTRACT

Application of plastic mulches, especially the aluminized and the white/black, resulted in significant increases in the "marketable" and "total " squash yields and fruit counts over the control and paper mulch. Flowering, fruit set and growth were enhanced to similar extents by plastic mulch treatments. However, highest fruit set and lowest ratio of aborted to set fruits were recorded for the white/black and aluminized mulches.

The aluminized mulch was more effective in deterring aphids (the vector of watermelon mosaic virus-2) and reduced the disease incidence especially early in the season. However, both growth and yield and their components were almost similar for all the plastic mulch treatments.

Therefore, it is recommended to use aluminized, white/black, black and black/white mulches only for squash production under conditions similar to this investigation. Use of paper mulch should be avoided.

Key words: Aphis spp., Mulch , Squash, Watermelon Mosaic Virus-2.

INTRODUCTION

Mulching has been widely used to increase production (Courter and Oebker, 1964; Haddadin and Ghawi, 1984 ; Tiessen, 1977), promote earlier yields (Courter and Oebker, 1964) and improve growth (Courter and Oebker, 1964; Knavel and Mohr, 1967 ; Suwwan and Judah, 1985) and quality (Suwwan and Judah, 1985) of several vegetables including squash.

Black and brown paper and black polyethylene mulches similarly increased early and total yields of summer squash and cucumber (Courter and Oebker, 1964). Among 12 polyethylene materials, the black mulch resulted in the highest tomato yields (Tiessen, 1977). According to Suwwan and Judah (1985) , the white/black plastic mulch significantly increased the early marketable and tended to increase the total marketable yields of plastic house tomatoes as compared with the black mulch and bare soil treatments. Plastic mulches resulted in earliest fruit set and gave highest muskmelon yields (Shales and Sheldrake, 1965). Heavier production of flowers was obtained from cantaloupe plants mulched with black polyethylene (Clarkson and Frazier, 1957).

Summer squash and cucumber plants mulched with either paper or black polyethylene , grew more rapidly during the early part of the season (Courter and Oebker, 1964). Clear, black polyethylene and paper laminated with black polyethylene showed similar effects on root growth of summer squash plants; but unmulched roots were longer than the control (Knavel and Mohr, 1967). While the white/

black and black plastic mulches (Suwwan and Judah, 1985) enhanced vegetative growth of tomato plants, the transparent, black and bare soil treatments gave similar effects (Haddadin et al., 1985) .

Clear (Haddadin and Ghawi, 1984 ; Knavel and Mohr, 1967), black(Knavel and Mohr, 1967 ; Shales and Sheldrake, 1965) and paper (Block and Rolston, 1972 ; Clarkson and Frazier, 1957 ; Courter and Oebker, 1964) mulches were effective in increasing soil temperature but to variable extents. According to Schales and Sheldrake (1965) , early season soil temperature was not affected by the white plastic mulch. Soil temperatures four inches under unshaded mulch were increased by black polyethylene and to a lesser degree by paper (Courter and Oebker, 1964). Mulch materials were also reported to conserve soil moisture (Haddadin and Ghawi, 1984).

Schalk et al. (1979) using aluminum and aluminized, white and black plastic mulches found aluminum as the most effective film mulch in deterring insects and reducing insect damage to vegetable fruits. Reflective mulches were also reported to reduce aphid-borne virus diseases in squash (Moore et al., 1965) and pepper (Block and Rolston, 1972).

Cucurbits including squash are severly affected by aphid-borne mosaic diseases (Al-Musa and Mansour, 1982) with watermelon mosaic virus-2 most predominant in Jordan (Mansour and Al-Musa, 1982).

So far, yield responses of summer squash to paper and black, black/white, white/black and aluminized plastic films were not determined. As well, the incidence of the aphid-borne WMV-2 and its impact on squash yields, in presence of these films, has not been assessed yet.

MATERIALS AND METHODS

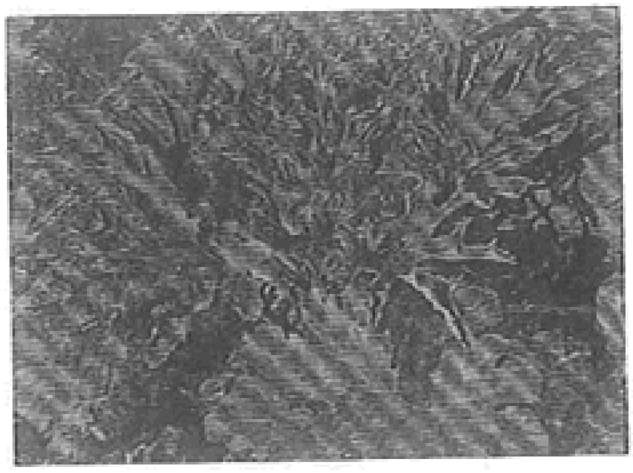
This experiment was conducted during the spring of 1983, at the Jordan University Farm located in the Central Jordan Valley. Five mulch films i.e. paper, aluminized black, white/black and black/white plastic and bare soil were evaluated in terms of squash growth, yield and incidence of WMV-2. A randomized complete block design with four replicates was used. Each treatment consisted of four 7 m rows, 1 m apart with hills spaced at the dripper site (0.4 m within the row).

Squash seeds ,cv.Victoria were direct seeded in April 4, 1983. Irrigation was accomplished by a drip irrigation system. Diseases caused by fungi were controlled by spraying appropriate fungicides. No insecticides were used to avoid any effects on the population of aphids, the vector of WMV-2. Yellow water traps (yellow plastic pans, 40 cm in diameter, half filled with water mixed with detergent) were assigned to the center of each plot. Aphids landing in these traps were counted throughout the period, May 3 to June 6, 1983. Incidence of mosaic diseases was determined visually (Fig. 1-a) by calculating the percentages of infected plants at weekly intervals starting 21 days after planting.

Squash fruits were harvested at two day intervals throughout the period May 23 to June 13, 1983 . The three week harvest period was equally divided into early, mid and late season. Fruits showing viral symptoms (Fig. 1-b) were counted and considered unmarketable. Counts of female flowers (both set and aborted) and male flowers were determined by the end of the experiment. Plants in each plot were cut down to the soil surface and separated into leaves and stems. Representative samples were then dried to a constant weight at 70 C and dry matter contents of leaves and vegetative growth were determined.

All data obtained were analyzed as for the randomized complete block design (Little and Hills, 1978) ; mean seperation using DMRT and correlation coefficients were also performed.

(A)



(B)

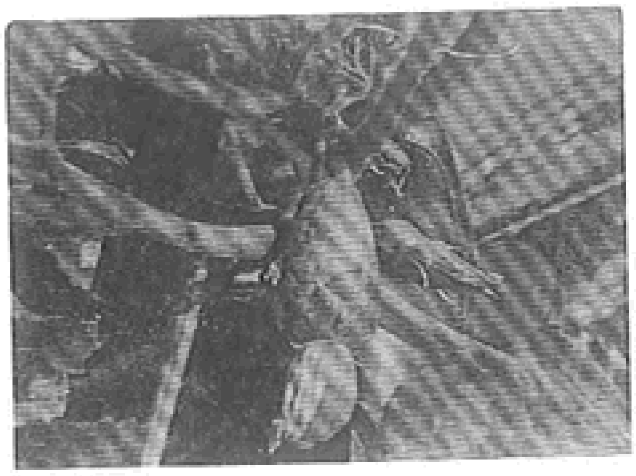


Fig.1 Squash plants (A) and fruits (B) showing the typical symptoms of WMV-2.

RESULTS

Yield and fruit counts :

Application of plastic mulches resulted in significantly higher squash yields (Fig. 2). Marketable yield increases, compared with the control, were 243, 226, 201, 177 and 76% for the aluminized, white/black, black, black/white and paper mulches, respectively.

Unmarketable squash yields (Fig. 2) were significantly highest for the white/black compared to the other treatments, except for the black/white mulch which gave significantly similar but lower yields. Mulch types other than the white/black, gave similar unmarketable squash yields. However, least unmarketable yields were obtained from the control.

Total yields (Fig. 2) were similar for all the plastic films which produced significantly higher yields than both the paper and control treatments. Percent total yield increases over the control were considerably high for the plastic (230-318 %) and paper (113%) mulches.

In terms of fruit counts obtained (Fig. 3), mulch types exerted effects similar to those described herein for their corresponding yields (Fig. 2).

Flowering and fruit set :

Mulching effectively enhanced flowering, fruit set and abortion (Fig. 4). Though significantly similar,

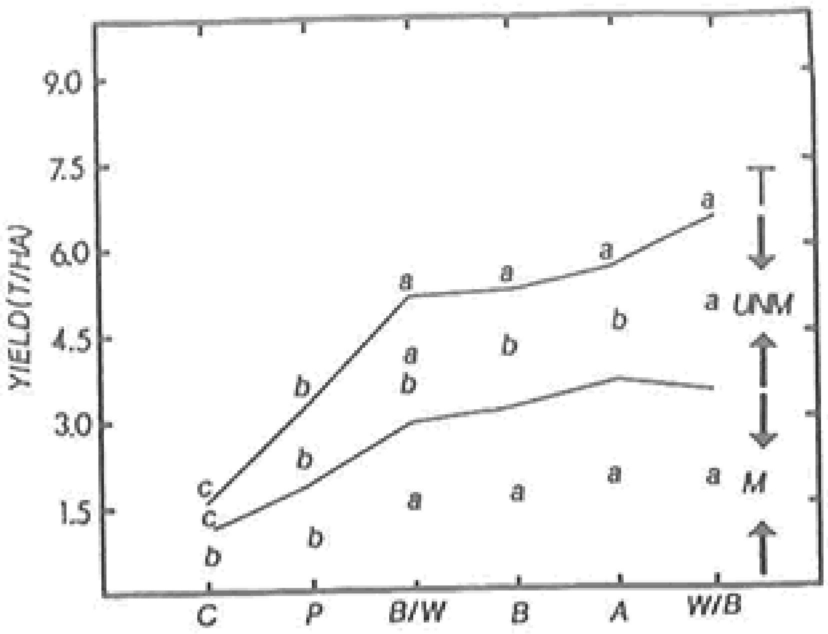


*Fig.*2 Effect of mulch types (C. control, P: paper, B/W: black/white, B: black, A: aluminized and W/B white/black) on squash yield (within each yield category, values having different letters are significantly different at the 0.05 level according to DMRT).

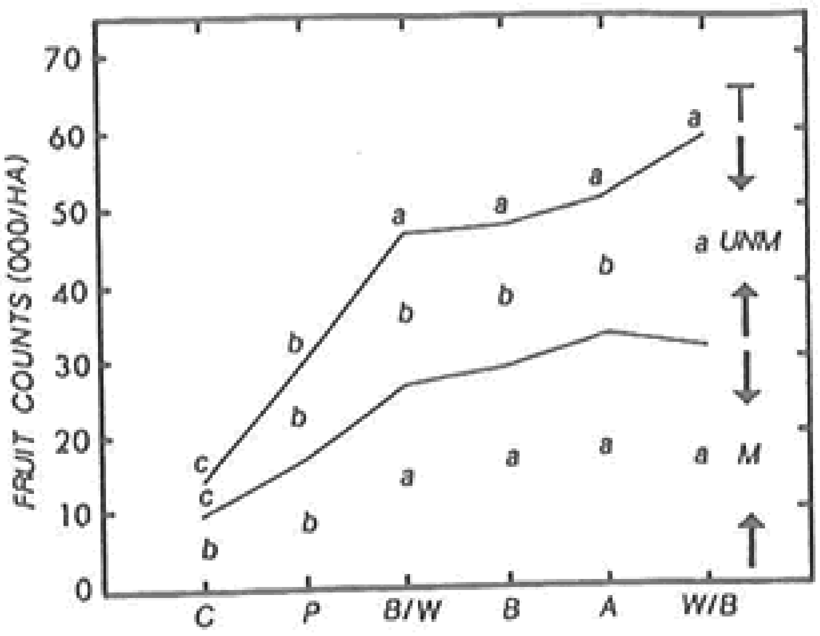


*Fig.*3 Effect of mulch types (C: control , P: paper, B/W: black/ white, B: black, A: aluminized and W/B : white/ black) on squash fruit counts (within each fruit count category, values having different letters are significantly different at the 0.05 level according to DMRT).

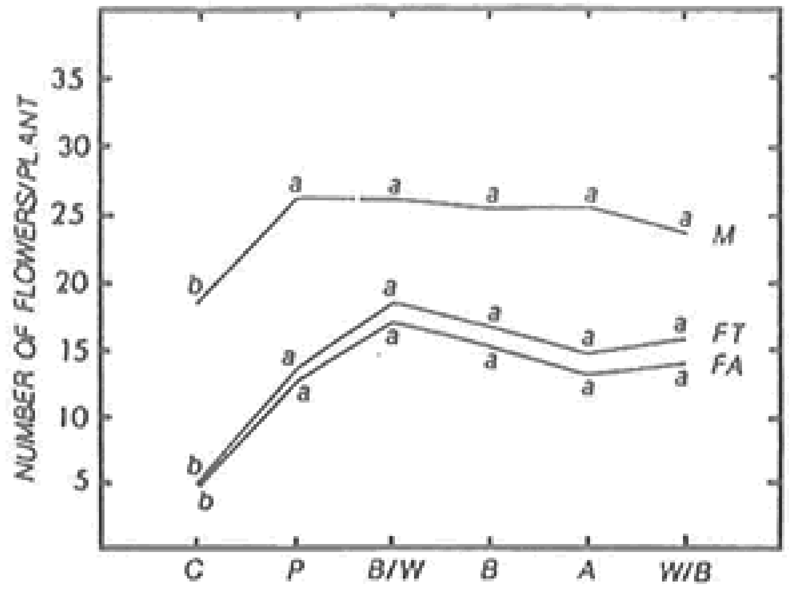


Fig.4 Effect of mulch types (C: control, P: paper, B/W: black/ white, B: black, A: aluminized and W/B : white/ black) on sex expression and fruit set in squash (values on each curve having different letters are significantly different at the 0.05 level according to DMRT).

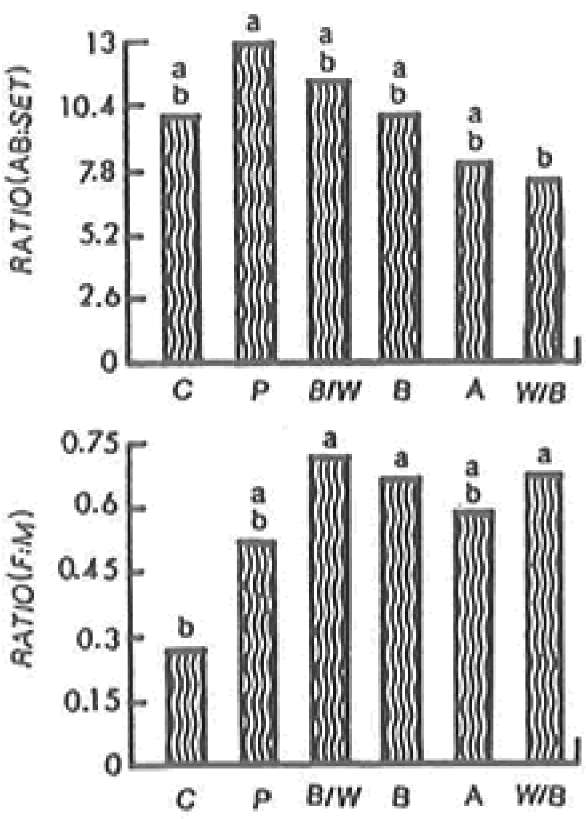


Fig.5 Effect of mulch types (C : control , P: paper, B/W: black/ white, B: black, A: aluminized and W/B : white/ black) on aborted / set and female/ male ratios in squash (columns having different letters are significantly different at 0.05 level according to DMRT).

highest number of female and aborted squash flowers were obtained from the black/white mulch followed by the black, white black, aluminized and paper mulches.

Plastic mulches resulted in a significantly similar fruit set with the white/black and aluminized giving the highest values. Significantly lowest fruit set was recorded for the control and paper mulches (Fig. 4) . The ratio of aborted to set fruits (Fig. 5-a) was lowest for the white/black and aluminized mulches ; highest ratios were recorded for the paper mulch followed by the other treatments including the control.

Among the significantly similar mulch treatments, number of male flowers (Fig. 4) was highest for the black/white and paper mulches and lowest for the white/black mulch. Female : male ratio (Fig. 5-b) was highest for the black/white and white/black and black mulches followed by the aluminized, paper and the control.

Plant growth :

Plastic mulches resulted in signigicant increases of the dry weight of leaves (Fig. 6-a) over both the paper mulch and the control. Effects of black , black/white and aluminized mulches on vegetative dry weight were similar (Fig. 6-b) ; vegetative growth obtained from the white/black mulch was similar to that of the paper mulch. For both the leaves and vegetative growth, the paper mulch proved significantly superior to the control .

Incidence of WMV-2 :

Incidence of the mosaic disease (Table 1) was consistantly lower in the plots covered with the aluminized mulch for the first 6 weeks after seedling emergence compared to all other treatments. Five weeks from emergence, however, cumulative disease incidence was similar in the white/black and the black which were significantly higher than the aluminized but similar to the control and the black/white mulch. During this period highest disease incidence was recorded for the paper mulch followed by the black/white and the control. After 6 weeks from emergence the aluminized, the white/ black and the control resulted in similar cumulative disease incidence but were significantly lower than the other treatments. Seven weeks from emergence, differences among the treatments diminished with the aluminized mulch, still giving lowest disease incidence.

DISCUSSION

Similar to earlier findings on tomato (Haddadin et al ., 1985; Suwan and Judah, 1985; Tiessen, 1977), muskmelon (Shales and Sheldrake, 1965 ; Tiessen, 1977) cucumber and squash (Courter and Oebker, 1964) plastic mulches effectively increased the marketable squash yields(Fig.2). The favorable effects of mulch materials on soil temperature (Haddadin and Ghawi, 1984; Shales and Sheldrake, 1965) and soil moisture contents (Haddadin and Ghawi, 1984) might have contributed to higher squash yields obtained (Fig. 2). Mulchin also

Table (1) Effect of mulch type on incidence of WMV- in Squash

Mulch type	Days after emergence[a]				
	21	28	35	42	49
	Incidence(%)				
Control	3 a [1]	10 a	48 ab	81 b	98 a
Paper	2 a	21 a	65 a	97 a	100 a
Black/white	1 a	12 a	51 ab	98 a	99 a
Black	1 a	10 a	35 b	93 a	98 a
Aluminized	0 a	1 b	14 c	71 b	90 a
White / balck	1 a	11 a	36 b	78 b	99 a

A- Within columns, values having different letters are significantly different at the 0.05 level according to DMRT.

increased plant growth (Knavel and Mohr, 1967; Shales and Shelkrake, 1965) with consequent enhancement of crop yields. The increased leaf and vegetative growth, particularly in the plastic mulch treatments (Fig. 6), along with the significantly high correlation coefficients (0.69 and 0.67, respectively) with squash yields obtained (Table 2) are supportive to the positive conbtribution of better vegetative growth to higher squash yields.

As plants developed, better vegetative growth (Fig. 6) flowering and fruit set (Fig. 4) were enhanced (r= 0.82 and 0.81). Though fruit abortion was significantly higher for the plastic mulch treatments, yet more fruits were observed to set (Fig. 4). This indicated that better vegetative growth is likely to support higher female flowers giving more chances for fruits to set rather than to abort. Consequent higher squash yields (r= 0.8 and 0.6, respectively) were, therefore, obtained . Fruit number, as an important yield component, has been also reported for other crops such as tomato (Suwwan and Judah, 1985).

That incidence of WMV-2 contributed to the present plant growth (Fig.6), yield (Fig.2), flowering and fruit set (Fig.4) is inevitable . Forty nine days after planting (42 days after emergence) , and for a six week period, the aphid population was assessed (Fig.7,8 and 9). The high aphid population and the appearance of WMV-2 symptoms indicated that the infection with the disease occurred during critical periods of the crop growth and reproduction (Fig. 7). In general, agreement with earlier findings (Block

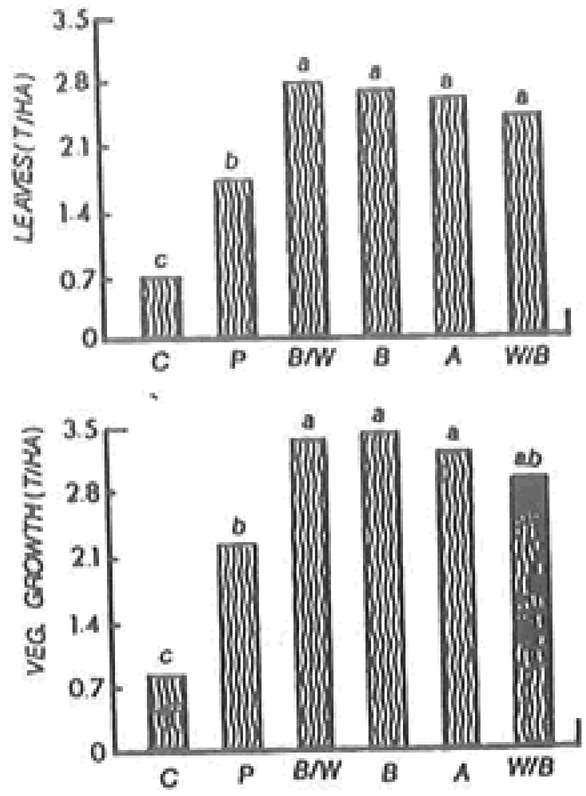


Fig.6 Effect of mulch types (C: control, P: paper, B/W: black/ white, B: black, A: aluminized and W/B : white /black) on dry matter contents of leaves (A) and vegetative growth (B) in squash (columns having different letters are significantly different at 0.05 level according to DMRT).

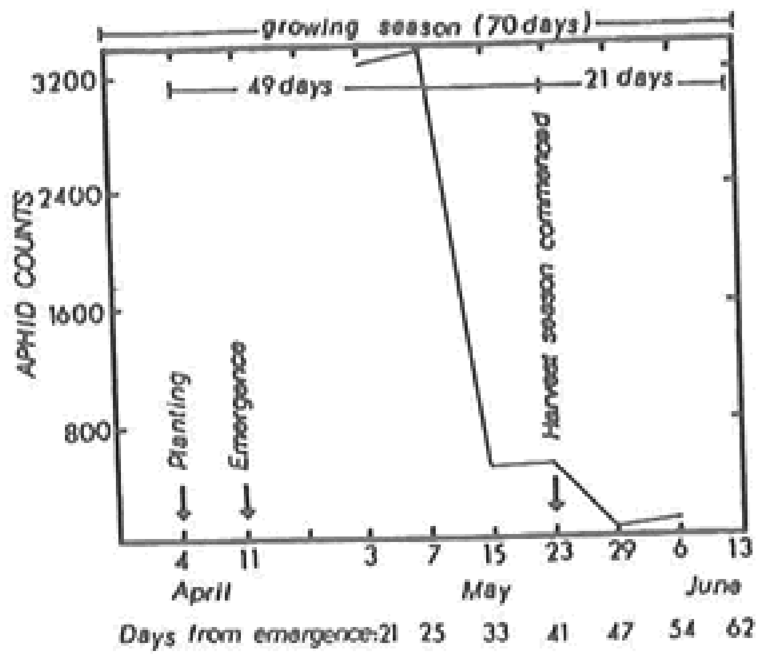


Fig.7 Population dynamics of the aphids over the experimental site (672 m^2 effective area).

Table (2) correlation coefficients (r) [a]

	Independent				
Dependent	Female flowers			Growth	
	Set	Aborted	Total	Leaves	Vegetative
Yield	0.80	0.60	0.63	0.69	0.67
Female - Set	....	....	0.70	0.82	0.81
- Aborted	....	....	0.99	0.82	0.82
- Total	....	....	....	0.85	0.85

a - All values are significant at the 1% level.

.... Values not determined.

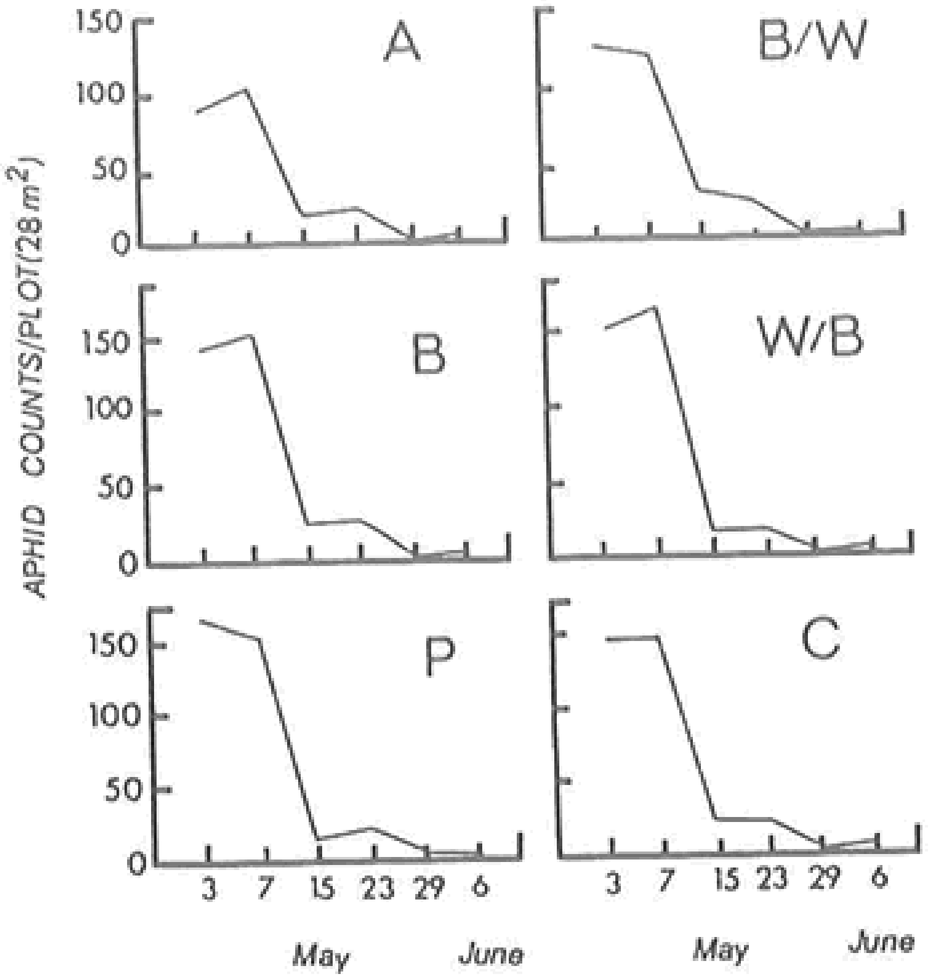


Fig.8 Individual effects of mulch types (C: control, P: paper, B/W : black/ white, B: black, A: aluminized and W/B: white / black) on dynamics of aphid population .

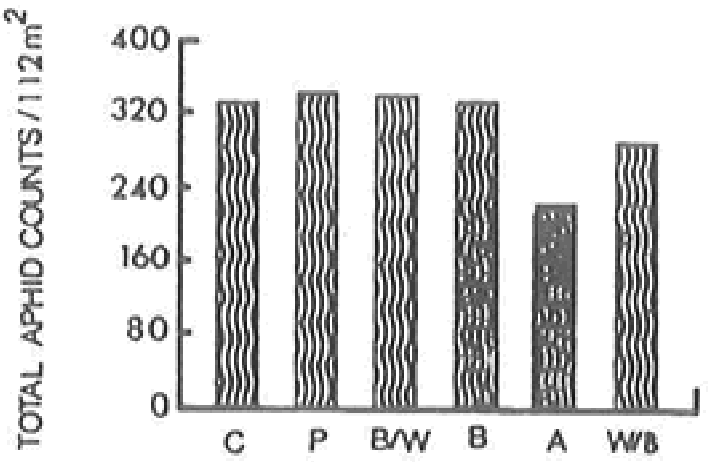


Fig.9 Effect of mulch types (C: control, P: paper , B/W: black/ white, B: black, A: aluminized and W/B : white/ black) on total aphid counts.

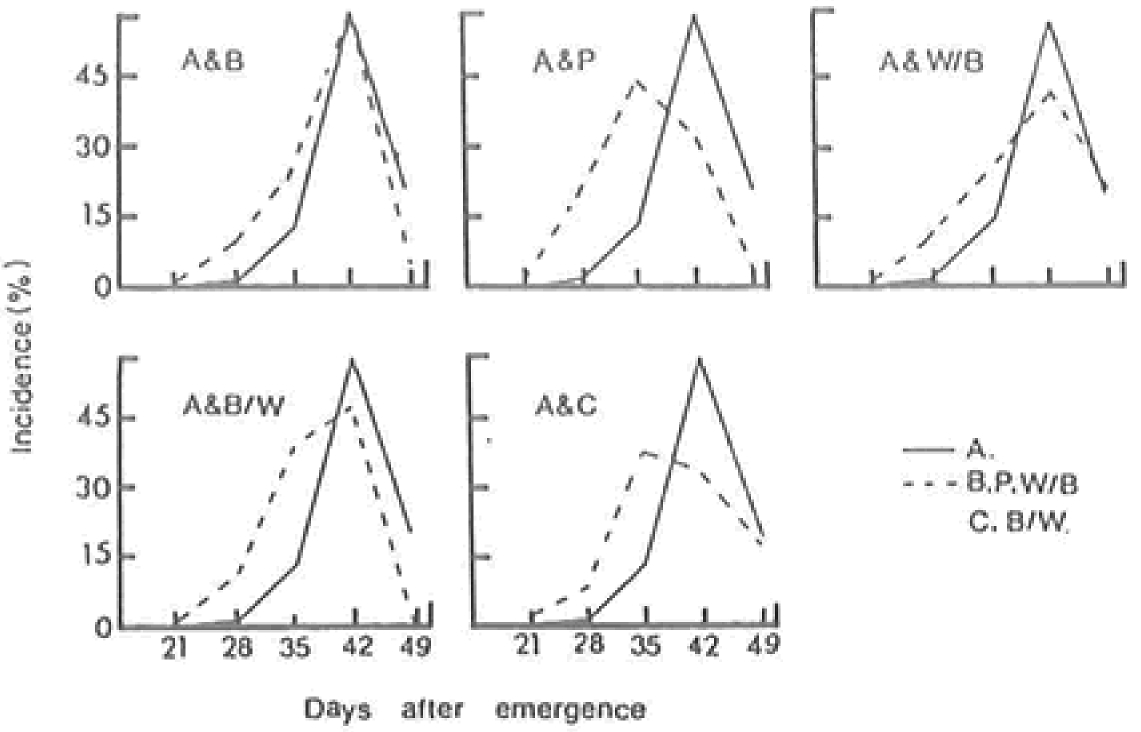


Fig.10 Delay in incidence of WMV-2 disease by the aluminized mulch over the other mulch treatments (C: control, P: paper, B/W: black/ white, B: black, A: aluminized and W/B: white/black).

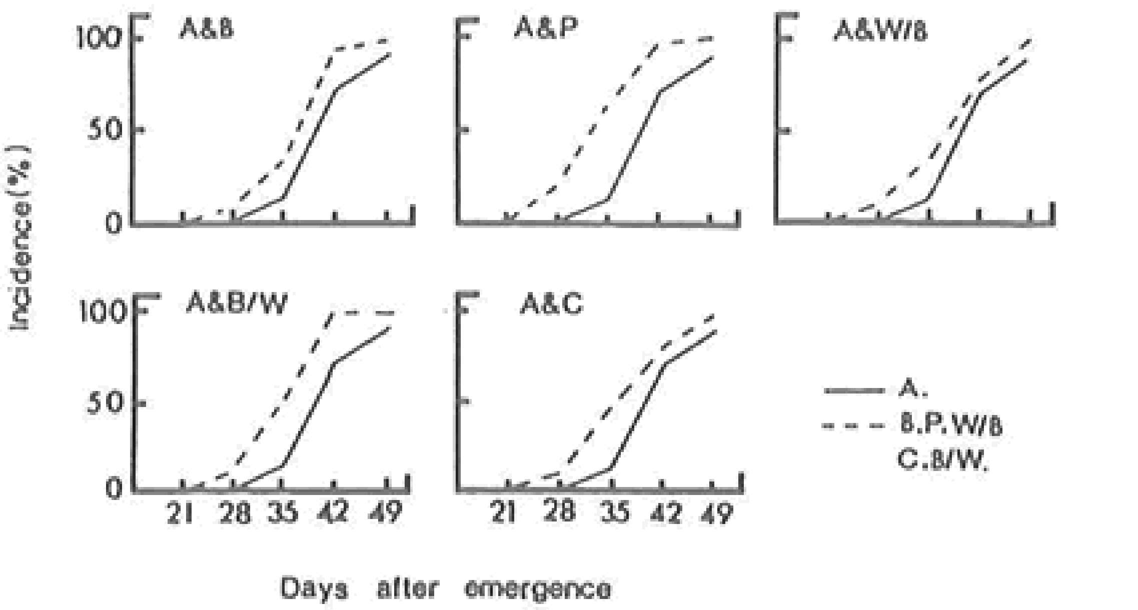


Fig.11 Cumulative incidence of WMV-2 for the different mulch treatments compared with the aluminized mulch (C: control, P: paper, B/W : black/ white, B: black, A: aluminized and W/B: white/black).

and Rolston, 1972; Moore et al., 1965; Schalk et al., 1979), the aluminized mulch was more effective in repelling the aphids as evidenced by the aphid counts (Fig.8) and the consequent delay in infection with WMV-2 (Fig. 10 and 11). The disease not only deformed the vegetative growth of the plant (Fig. 1-a) (reducing its photosynthetic capacity with a consequent failure to support more fruits), but fruit quality was also marred (Fig. 1-b) and rendered unmarketable. It is unlikely, however, that mulches other than the aluminized has boosted squash yields in a similar manner. That effectiveness of the aluminized mulch was reduced, towards the end of the growing season is most likely due to dirt accumulation and increased shading by the plant canopy.

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مجلة الامارات للعلوم الزراعية (١٩٩٠) ، ٢ : ١٧-٣٦

تأثر انتاج ونوعية صنف الكوسا "فكتوريا" بنوع الملش بوجود مرض موزاييك البطيخ الفيروسى -٢

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ملخص

أدى استعمال البلاستيك ملش ، خاصة الفضي والابيض / أسود ، الى زيادات معنوية في الانتاج المسوق والكلي وعدد الثمار المسوق والكلي مقارنة بالشاهد والملش الورقي. وزاد الازهار وعقد الثمار والنمو بدرجات متماثلة في معاملات الملش البلاستيكي المختلفة وأعطت المعاملتان، الملش الابيض/ الاسود والملش الفضي أكبر عدد من الثمار العاقده وأقل نسبة من الثمار "غير العاقدة : العاقدة".

كان الملش الفضي أكثر فعالية في طرد حشرة المن (ناقلة مرض موزاييك البطيخ الفيروسي-٢) وتقليل الاصابة بالمرض خاصة مبكرا في موسم النمو، الا ان النمو والانتاج ومكونات كل منهما كانت متشابهة في جميع معاملات الملش البلاستيكي.

لذلك ينصح باستخدام الملش الفضي ، الملش الابيض/ اسودوالملش الاسود/ابيض فقط لانتاج الكوسا تحت ظروف مماثلة لظروف هذه الدراسة . ويجب تجنب استعمال الملش الورقي .

كلمات مفتاحية : حشرة المن ، الملش ، الكوسا ، مرض موزابيك البطيخ الفيروسي -٢