EFFECT OF DRIP IRRIGATION AND MULCHING ON QUALITY OF TOMATO FRUITS

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Abstract

The aim of the investigation was to evaluate the effect of drip irrigation and mulching with black polyethylene plastic on the yield and fruit quality of two tomato cultivars. Irrigation evidently increased total yield by 16 % and marketable yield by about 28 % in comparison to plots without irrigation. Mulching with black plastic also increased total yield by about 20 % and marketable yield by about 24 %. Irrigation and mulching did not show any influence on the early yield of tomatoes. In the condition of irrigation and mulching the higher marketable yield was found for cv. Luca in comparison to cv. Radek. The drip irrigation gave an evident increase of fruit weight and fruit compression resistance in comparison to non-irrigated plants. Drip irrigation decreased the amount of carbohydrates, fiber and nitrates in tomato fruits. Mulching with black plastic increased compression resistance of tomato fruits. Irrigated plants of cv. Luca showed a lower content of vitamin C, organic acids, pH value, and worse color in comparison to fruits of cv. Radek. Interaction of irrigation, mulching and cultivar was evidently shown on the content of dietary fiber. Irrigation and mulching decreased content of soluble fiber in tomato fruits of both tested cultivars.

1. Introduction

Water deficiency in Poland is an important factor which makes it impossible to intensify horticultural production (Kaniszewski, 1990). Will (1966) reports that cabbage, celery and tomato - among the vegetable plants - have the highest needs for water during growth period. Mulching has been applied in tomato cultivation for several years to obtain higher total and early fruit yield (Wien and Minotti, 1988; Bogle et al., 1989). Application of plastic increased the nitrogen availability, soil temperature and decreased moisture content of soil (Lipinski and Lipinska, 1984; Sweeney et al., 1987). Beneficial effect of mulching on soil moisture content appears clearly in the initial period of plant growth and is relatively short. Due to difficulty in water permeation under the plastic in the later period of cultivation the plants can show evident deficiency of water. Water supply to plants cultivated under plastic is possible only by drip irrigation. Bhella (1988) and Bogle et al., (1989) have shown the highest yield of tomato when mulching and drip irrigation were applied together with most effective use of water.

The aim of the investigation was to evaluate the effect of drip irrigation and mulching with black plastic on the yield and fruit quality of two tomato cultivars.

2. Material and methods

The three factor experiments in a split - plot system on the effect of drip irrigation and mulching on yield and quality of tomatoes were carried out in 1989-1991 on sandy-loam soil (pH=6, organic matter content 1.16 %, available water

capacity 12.5 mm at 0.1 m). Drip irrigation, mulching and cultivar were the investigated factors. The treatments included: 1. drip irrigation (irrigated and non-irrigated plots), 2. black polyethylene mulch (mulched and non-mulched plots), 3. two tomato cultivars (Luca and Radek). Tomatoes were transplanted at a spacing of 50 x 40 x 95 cm. The following fertilizers were applied: 150 kg N/ha, 100 kg P_2O_5/ha and 200 kg K_2O/ha. Terms of irrigation were evaluated by the use of irrometers. Water was applied at the amount of 2 L per plant when soil moisture tension was at a level of 30-40 kPa. Tomatoes were harvested several times and total, marketable and early yield were estimated. Fully ripe and healthy fruits were used for chemical determinations of dry matter, carbohydrates, organic acids, acidity (pH), vitamin C, pectins, fiber and nitrates. Among physical measurements, color of fruits and their compression resistance were evaluated.

3. Results

3. 1. Yield

The effect of irrigation and mulching with plastic on yield of tomatoes is illustrated in Fig. 1. Drip irrigation had no effect on early yield of tomato fruits but increased total yield by 16 % and marketable yield by 28 % as compared to non-irrigated tomatoes. Rudich et al., (1979) have reported similar results. Mulching with black plastic did not affect the early yield but increased total yield by 20 % and marketable yield by 24 %. Vandenberg and Tiessen (1972) and Wien and Minotti (1988) have shown the beneficial effect of mulching on early yield of tomatoes too. Non significant interaction of irrigation and mulching on yield of tomatoes was found. In the condition of irrigation and mulching the higher marketable yield was found for cv. Luca in comparison to cv. Radek.

3. 2. Quality of fruits

The investigated factors significantly affected some quality parameters of tomato fruits. Drip irrigation significantly increased weight and compression resistance of tomato fruits in comparison to non-irrigated plants. No differences in color of fruits between irrigated and non-irrigated plants were found (Table 1.) Similar results were obtained in earlier experiments (Kaniszewski and Elkner, 1987, 1990). Sanders et al., (1989) have shown that irrigation increased the weight of fruits and improved fruit color. Drip irrigation decreased the content of dry matter and vitamin C (Table 2). Differences in content of these components were not significant. Irrigation significantly decreased the levels of carbohydrates, pectins, dietary fiber and nitrates. Comparable results regarding the content of dry matter, carbohydrates, vitamin C and organic acids were obtained by Rudich et al., (1977) and by Kaniszewski and Elkner (1987). Mulching with black plastic increased compression resistance of fruit but had no influence on the weight and color of fruits and chemical composition of tomatoes (Table 1 and Table 2). Fruits of the compared cultivars differed significantly in physical and chemical characteristics. The interaction of drip irrigation and cultivar, as well as interaction of irrigation, mulching and cultivar on some quality parameters of fruit were found. Irrigated plants of cv. Luca showed a lower content of vitamin C (Fig. 2), organic acids, pH value and worse color (Fig. 3) than fruits of cv. Radek. Interaction of irrigation, mulching and cultivar on dietary fiber content was observed too. Irrigation and mulching significantly decreased the content of insoluble dietary

fiber in fruits of cv.Radek and decreased the soluble dietary content in fruits of both cultivars (Fig. 4 and Fig. 5).

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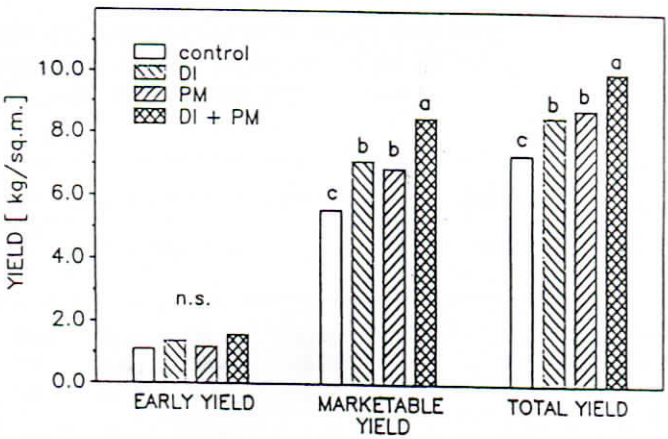

FIG. 1. EFFECT OF DRIP IRRIGATION (DI) AND POLYETHYLENE MULCHING (PM) ON THE TOMATO YIELD.

TAB. 1. EFFECT OF DRIP IRRIGATION, MULCHING AND CULTIVAR ON SOME PHYSICAL PROPERTIES OF TOMATO FRUITS.

Treatments	Fruit weight (g)	Color (a/b)	Compression force (N)
No irrigation	85.8	2.1	51.9
Irrigation	109.7	2.1	64.7
LSD (α=0.05)	9.3	n.s.	8.9
No mulching	96.4	2.1	56.2
Mulching	99.1	2.1	60.4
LSD (α=0.05)	n.s.	n.s.	2.2
Cultivars:			
Luca	99.5	2.0	66.3
Radek	96.0	2.3	50.4
LSD (α=0.05)	n.s.	0.1	4.2

TAB. 2. EFFECT OF DRIP IRRIGATION, MULCHING AND CULTIVAR ON SOME CHEMICAL COMPONENTS OF TOMATO FRUITS.

Treatments	Dry matter %	Sugars %	Vitamin C mg/100g	Pectins %	Total dietary fibre %	Nitrates mg/kg
No irrigation	7.28	3.33	26.4	0.45	1.63	39.1
Irrigation	6.38	2.96	25.4	0.36	1.41	22.8
LSD (α=0.05)	n.s	0.30	n.s.	0.04	0.05	7.0
No mulching	6.92	3.27	26.0	0.43	1.56	32.5
Mulching	6.73	3.03	25.7	0.37	1.48	29.5
LSD (α=0.05)	n.s.	0.14	n.s.	0.02	n.s.	n.s.
Cultivars:						
Luca	7.00	3.43	30.4	0.44	1.61	34.4
Radek	6.84	2.87	21.4	0.36	1.44	27.6
LSD (α=0.05)	0.11	0.12	2.0	0.03	0.10	4.0

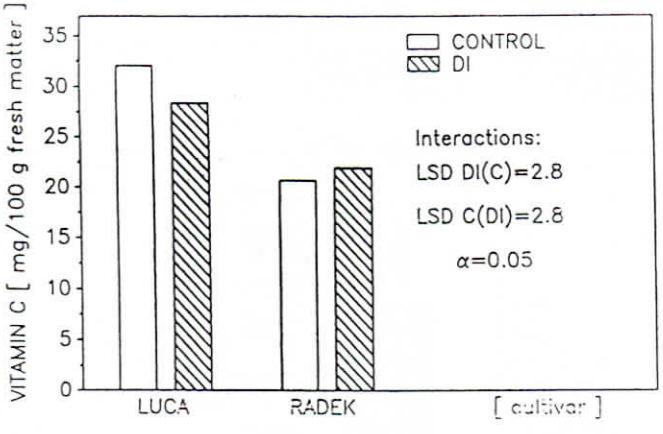

FIG. 2. EFFECT OF DRIP IRRIGATION (DI) AND CULTIVAR (C) ON VITAMIN C CONTENT IN TOMATO FRUITS.

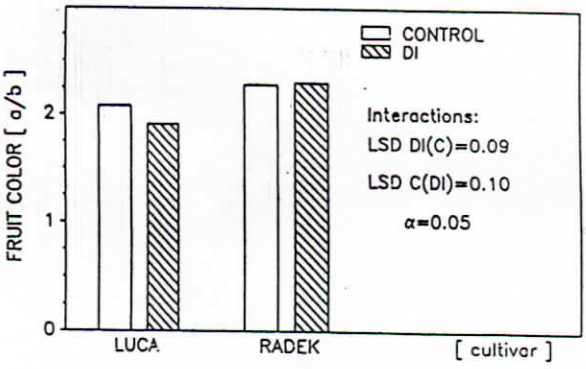

FIG. 3. EFFECT OF DRIP IRRIGATION (DI) AND CULTIVAR (C) ON COLOR OF TOMATO FRUITS.

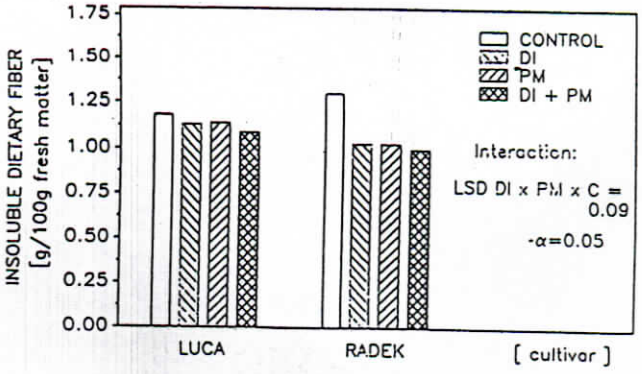

FIG. 4. EFFECT OF DRIP IRRIGATION (DI), POLYETHYLENE MULCHING (PM) AND CULTIVAR (C) ON INSOLUBLE DIETARY FIBER IN TOMATO FRUITS.

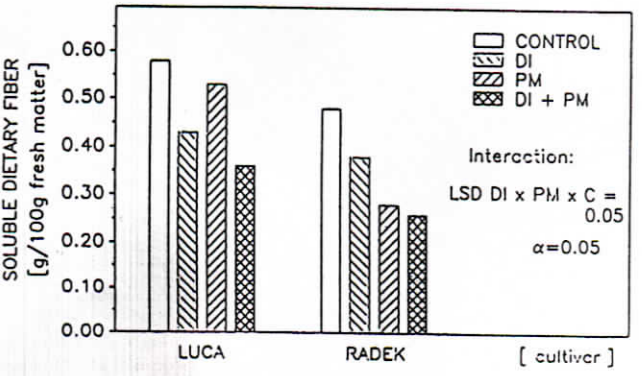

FIG.5. EFFECT OF DRIP IRRIGATION (DI), POLYETHYLENE MULCHING (PM) AND CULTIVAR (C) ON SOLUBLE DIETARY FIBER IN TOMATO FRUITS.