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Effect of paddy straw mulch, irrigation regimes and nitrogen levels on the performance of spring transplanted bell pepper in semi-arid environment of South-Western Punjab

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Abstract

A 4-years study was conducted to investigate the effect of three irrigation levels (I_1= IW/CPE=0.6, I_2=0.9, I_3=1.2) and three nitrogen levels (N_1=100 kg/ha, N_2=125 kg/ha, N_3=150 kg/ha) on growth, yield, quality and water use efficiency (WUE) of spring transplanted bell pepper with paddy straw mulching (PSM) @ 6 t/ha (M_1) vis-à-vis without mulching (M_0). Significantly higher fruit yield was recorded with higher number of irrigations (I_3) as compared to I_1 and I_2 levels. The fruit yield under M_0I_3 was statistically at par with that under M_1I_2 implying saving of 5-7 irrigations by using PSM. Low nitrogen fertilization with PSM (N_1M_1) yielded at par with higher nitrogen fertilization without mulching (N_3M_0) revealing that 50 kg N/ha may be saved by using PSM. The dry matter, ascorbic acid and chlorophyll (a, b and total chlorophyll) in fruits harvested from M_1 plots were higher than those from M_0 plots whereas, the capsaicin content in fruit was 14.6% lower in M_1 plots than those from bare soil. The dry matter, vitamin C and chlorophyll (a, b and total) in fruits were the lowest in I_1 and the highest values were recorded in I_3 whereas the capsaicin content exhibited the contrary trend. A significant increase in fruit dry matter, ascorbic acid and chlorophyll (a, b and total); and a decrease in capsaicin content was observed with increase in nitrogen dose from 100 kg/ha to 150 kg/ha. Water use (WU) was slightly higher under M_0 as compared to M_1 plots, whereas, the WUE and profile water use (PWU) were higher in M_1 than in M_0 plots**.** The WU and PWU exhibited an increasing trend with increasing frequency of irrigation whereas the WUE showed a decreasing trend. The WU and WUE values were the highest at N_3 and the lowest at N_1 level. The organic carbon, available nitrogen, phosphorus and potassium content of surface soil (0-15 cm) increased with PSM than those in bare soil.

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Key words: Mulching, Irrigation, Bell pepper, Capsaicin, Water use efficiency

Introduction

Bell pepper (*Capsicum annuum* L.) is a remunerative crop cultivated under assured irrigation conditions in South-Western Punjab. It is a very good source of vitamin C, ß carotene, rutin (a bioflavonoid), minerals and capsaicin. Capsaicinoids are alkaloid compounds that produce the pungency associated with peppers. Besides, in the chloroplasts of higher plants, two kinds of chlorophyll are found, chlorophyll a (blue-green) and chlorophyll b (yellow-green), which differ in the substituent of a pyrrole ring II. In addition to its photosynthetic role, it is used as a natural pigment in food and cosmetics (Reid 2011). In plains of North-Western India, bell pepper in open fields can be transplanted in autumn (November) or spring (February) seasons. Although the autumn transplanted crop generally yields higher than the spring transplanted crop, it requires protection from frost by plastic low tunnel which is labour and capital intensive. The spring transplanted crop gives the advantage that it does not require protection from frost and offers the scope of taking an additional short duration crop during November to January months. The most important factor that affects the growth and yield in peppers is the amount of irrigation water applied throughout the crop growth and development period (Yildirim et al. 2012). However, high evaporation losses in March and April demand frequent irrigation for proper growth and development of plants. Brackish nature of underground water, irregular supply of good quality canal water and poor water holding capacity of the soil in South-Western Punjab further aggravates the problem. Therefore, it becomes imperative to standardize the irrigation scheduling of spring transplanted crop and to look out for agronomic practices like mulching which conserve soil moisture and reduce evaporation losses.

In Punjab, paddy is cultivated over 3 million hectares

area. Nearly 20 million tons of paddy residues are burnt every year, deteriorating the environment and causing intense air smog. The paddy straw thus has to be used properly. Application of paddy straw as mulch in vegetable crops is propitious as it helps in regulating soil temperature, soil moisture, microbial count and weed population eventually improving the soil health and productivity (Kosterna 2014). Furthermore, nutrient supply, chiefly nitrogen, is the significant factor for crop growth and yield. Crop response to nitrogen varies with rate and timing of nitrogen application in relation to plant development. Nitrogen plays an important role as a constituent of protein, nucleic acid and chlorophyll. Adequate nitrogen affects the yield, quality, fruit size, shelf-life, colour and taste of vegetables (Hegde 1987). Therefore, the present study was conducted for 4-years to investigate the response of spring transplanted bell pepper hybrid 'Indra' to three irrigation levels and three nitrogen doses with paddy straw mulching vis-à-vis without mulching in a semi-arid environment of South-Western Punjab.

Material and Methods

The present study was carried out in a loamy sand soil at Punjab Agricultural University, Regional Research Station, Bathinda for four seasons i.e. during *rabi* 2010-11 to 2013-14. The experimental field is located at 30° 9' 36" North latitude, 74° 55' 28" East longitude with an altitude of 211 m. The soil was non-saline and alkaline having electrical conductivity = 0.143 dS m^{-1}, pH = 8.4, low organic carbon (0.25%), low available nitrogen (103.8 kg ha^{-1}), medium available phosphorus (13.1 kg ha^{-1}) and high available potassium (364 kg ha^{-1}). The experimental site is characterized by semi-arid climate with an average annual rainfall of less than 450 mm. The mean agro-meteorological observations of all the four years are illustrated in Fig. 1.

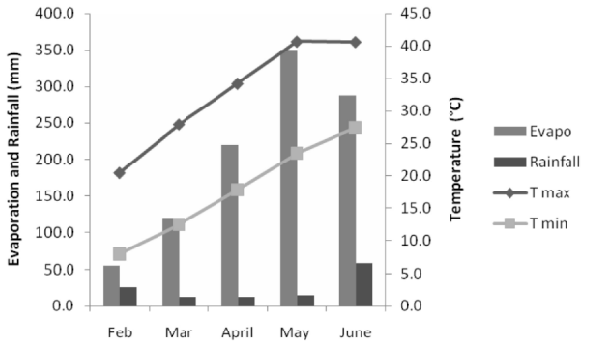

Figure 1: Rainfall, potential evaporation and mean temperature (mean of 4 seasons) during crop growth period at Bathinda

Eighteen treatments comprising two levels of mulching (main-plot treatment) i.e. paddy straw mulch (PSM) @ 6 t/ha (M_1) and without mulch (bare soil) (M_0), three irrigation levels (sub plot treatment) i.e. I_1 (IW/CPE=0.6), I_2 (IW/CPE=0.9) and I_3 (IW/CPE=1.2) and three nitrogen doses (sub sub plot treatment) i.e. N_1 (100 kg/ha), N_2 (125 kg/ha) and N_3 (150 kg/ha) were replicated thrice in a split-split plot design. The seedlings of bell pepper hybrid 'Indira' were transplanted in second fortnight of February. The transplanting was done in paired rows at intra-row spacing of 30 cm on beds which were 90 cm wide and raised 15 cm above ground level. Net plot size was 2.8 m × 4.0 m. The paddy straw mulch was uniformly spread on soil surface after transplanting. Furrow irrigation was applied throughout the crop season. For computation of water use efficiency (WUE), water use (WU) was calculated for different treatment combinations. The total water use expresses the sum of irrigation water applied, profile water used (PWU) and precipitation obtained during entire crop season. Soil moisture content was determined gravimetrically from the 0-180 cm soil depth. For working out WUE, fruit yield per hectare was divided by the water use and expressed as kg/ha-cm.

Five plants were selected at random from each plot to collect data on plant height, number of branches and marketable fruit yield. The fruits from second harvest were oven dried to a constant weight at 60±2°C for 48 hrs to estimate dry matter (%). Capsaicin in fruits (%) was estimated and calculated as per standard curve prepared by using pure capsaicin (Bajaj and Kaur 1979). Ascorbic acid in green fruits was estimated with indophenol dye method (Sadasivam and Manickam 1992). Chlorophyll a, chlorophyll b and total chlorophyll were estimated (Witham et al. 1971) and expressed in mg per g fresh weight. After harvesting of the crop, soil samples (0-15 cm depth) were collected, air-dried, grounded, sieved (2 mm) and were analyzed for pH (1:2 soil water ratio), electrical conductivity (EC) (1:2 soil water ratio), organic carbon (OC) (%), available nitrogen (kg ha^{-1}), available phosphorus (kg ha^{-1}) and available potassium (kg ha^{-1}). The 4-years data were pooled and analyzed following standard statistical methods using CPCS1 computer software programme developed by Punjab Agricultural University, Ludhiana.

Results and Discussion

Growth and yield parameters: Significant increase in plant height and number of branches was observed under PSM than in bare soil (Table 1). Gandhi and Bains (2006) have reported higher number of branches in tomatoes with straw mulch. The I_3 irrigation regime, where 21-

Table 1: Growth attributes, fruit yield and irrigation water use components of bell pepper as influenced by nitrogen and irrigation levels under varying mulch conditions (pooled data of four seasons)

Treatment	Plant height (cm)	Branches/plant	Profile water use (cm)	Water use (cm)	Fruit yield (t/ha)	Water use efficiency (kg/ha-cm)
Mulching						
No mulch (M_0)	38.2	18.4	12.6	79.4	8.63	113.0
Paddy straw mulch @ 6t/ha (M_1)	43.6	22.8	13.4	77.5	9.96	136.1
CD (P=0.05)	2.3	0.68	-	-	0.47	-
Irrigation regime						
I_1 = (IW/CPE= 0.6)	38.6	19.2	12.5	77.9	8.04	131.5
I_2 = (IW/CPE= 0.9)	41.3	20.9	13.1	78.5	9.41	127.2
I_3 = (IW/CPE=1.2)	42.8	21.7	13.5	78.9	10.43	115.0
CD (P=0.05)	2.6	1.8	-	-	0.37	-
Nitrogen levels						
N_1 = 100 kg N/ha	38.2	18.4	13.9	62.4	8.71	117.1
N_2 = 125 kg N/ha	41.9	20.1	13.0	76.9	9.37	125.2
N_3 = 150 kg N/ha	42.6	23.3	12.2	96.0	9.80	131.3
CD (P=0.05)	2.1	2.2	-	-	0.26	-

22 irrigations were applied, recorded the maximum plant height and number of branches, which were at par with I_2 (15-17 irrigations) and significantly higher than in I_1 irrigation regime (11-12 irrigations). Padron et al. (2015) have obtained the maximum height with 60% of the ETc (91.56 cm), when compared to 80% (74.75 cm) and 100% (72.44 cm) of the ETc. The N_2 (125 kg/ha) and N_3 (150 kg/ha) levels have recorded at par plant height which was higher than in N_1 (100 kg/ha). Similarly, the number of branches per plant was significantly higher in N_3 than N_2 and N_1 treatments. Islam et al. (2018) have also observed significant improvement in plant height and number of branches with increasing nitrogen dose as it activates the vegetative growth.

The fruit yield with PSM increased by 15.4% than that under bare soil which may be due to reduction in evaporation, consequently lowering the soil temperature and maintaining the moisture around root zone of plant, thereby increasing nutrient availability to plants. Mulch mitigates negative effect of water stress on plant growth and fruit yield in the field particularly in semi-arid situations (Sekhon et al. 2008). Significant increase in fruit yield was observed under I_3 as compared with I_2 and I_1 irrigation regimes which might be attributed to the fact that from mid-April onwards, the air temperature starts increasing drastically and the crop needs higher amount of water for fruit growth and development. Thus plants receiving lesser irrigations were under water stress while those receiving more number of irrigations were not under water stress. Sezen et al. (2011) have also reported that for higher yields, adequate water supply and uniform soil moisture is required during entire growing period. The higher irrigation had more number of fruits possibly because the plants were able to sustain development of more flowers up to the fruit maturity stage.

Application of nitrogen significantly improved the capsicum yield up to N_3 level (150 kg N/ha) over N_2 (125 kg N/ha) and N_1 (100 kg N/ha). Nitrogen-fertilized plants are able to partition a greater proportion of their

Table 2: Year wise fruit yield (t/ha) of bell pepper as influenced by nitrogen and irrigation levels under varying mulch conditions

Irrigation level	Fruit yield (t/ha)											
	2010-11			2011-12			2012-13			2013-14		
	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3	N_1	N_2	N_3
Without Mulch (Bare Soil)												
IW/CPE=0.6	5.83	6.05	6.19	7.66	8.01	8.53	7.32	8.09	8.50	7.39	7.80	8.08
IW/CPE=0.9	6.58	6.86	7.10	9.36	10.27	10.79	8.82	9.62	9.89	7.72	8.49	8.87
IW/CPE=1.2	6.71	7.03	7.27	11.10	12.05	14.44	10.05	10.97	11.10	8.17	8.85	8.99
Mean	**6.37**	**6.65**	**6.85**	**9.37**	**10.11**	**11.25**	**8.73**	**9.56**	**9.83**	**7.76**	**8.38**	**8.65**
With Paddy Straw Mulch												
IW/CPE=0.6	6.50	6.90	7.11	8.88	10.53	11.84	7.92	8.95	9.34	7.90	8.60	8.98
IW/CPE=0.9	7.61	7.88	8.06	12.29	12.60	12.83	10.26	11.12	11.37	8.61	9.43	9.50
IW/CPE=1.2	7.75	7.99	8.21	13.45	14.44	15.42	12.20	12.80	13.21	8.99	9.56	9.69
Mean	**7.29**	**7.59**	**7.79**	**11.54**	**12.52**	**13.36**	**10.13**	**10.96**	**11.31**	**8.50**	**9.20**	**9.39**
CD (P=0.05)												
A (Mulch)		0.68			0.53			0.90			0.43	
B (Irrigation)		0.24			1.00			0.68			0.49	
C (N levels)		0.18			0.76			0.70			0.26	

dry matter into fruits, resulting in a higher harvest index and fruit yield (Hegde 1987). The data of different years (Table 2) elucidate that the lowest fruit yield was recorded in $M_0I_1N_1$, while maximum yield was found in $M_1I_3N_3$. The values obtained during all the years under $M_0I_3N_3$ were statistically at par with $M_1I_2N_3$ which imply that under PSM, there may be saving of 5-7 irrigations as I_2 needed lesser irrigations than I_3. Similarly, comparable fruit yield was found under $M_0I_3N_3$ and $M_1I_3N_1$ signifying that a reduced amount of nitrogen (100 kg/ha) may give same yield under PSM than that with higher nitrogen level (150 kg/ha) without mulching.

Water use efficiency (WUE) indices: The water use (WU) was slightly higher under M_0 as compared to M_1 whereas profile water use (PWU) and WUE were higher under M_1 than with M_0 (Table 1). The organic mulch layer spread over the soil surface might have decreased the net radiation and soil temperature as a result the evaporation might have reduced the consumptive use of water. The WU and PWU exhibited an increasing order with increasing level of irrigation water applied whereas WUE registered a decreasing trend and the highest WUE was observed in I_1 (IW/CPE=0.6) level of irrigation and the lowest in I_3. Padron et al. (2015) have also observed decline in WUE with an increase in irrigation levels and the cumulative WUE from the mulched plots (6.0 g m^{-2} mm^{-1}) was significantly higher than that under bare soil (5.3 g m^{-2} mm^{-1}). Aladenola and Madramooto (2014) have recorded the highest WUE in bell pepper at 120% and 100% of evapo-transpiration replacement. The effect of nitrogen application on WU, PWU and WUE is not comparable. The highest PWU was under N_1 and the lowest values were recorded in N_3 (150 kg N/ha) whereas WU and WUE values were the highest in N_3 and the lowest under N_1.

Quality parameters: The capsaicin, ascorbic acid, dry matter and chlorophyll content are vital indexes of fruit quality as these determine the nutritional value and flavour of bell pepper. The dry matter, vitamin C, chlorophyll a, chlorophyll b and total chlorophyll in fruits exhibited a respective increase of 6.34%, 8.87%, 11.5%, 36.6% and 21.5% in M_1 than M_0, while capsaicin content was 14.6% lower in PSM plots than in bare soil plots (Table 3). The dry matter, ascorbic acid and chlorophyll (a, b and total) values were the lowest in I_1 whereas the highest values were recorded in I_3 followed by I_2 treatment. On the contrary, the capsaicin content in I_3 and I_2 irrigation regimes was at par and significantly lower than in I_1. Sekhon et al. (2008) and Kumar et al. (2016) have also observed a decrease in ascorbic acid content with lower irrigation frequency and an increase with the increase in irrigation level. Irrigation at a soil matric potential of -45 to -65 kPa resulted in significantly higher dry matter production as compared to very high or low frequency of irrigation at -25 or -85 kPa (Hegde 1988). The chlorophyll content has been observed to decrease with deficit irrigation in lemon balm and rosemary (Munne-Bosch and Alegre 1999). Chlorophyll loss is a negative consequence of water stress, however, it has been considered as an adaptive feature in plants grown under water deficit conditions (Munne-Bosch and Alegre 2000).

There was significant enhancement in dry matter, vitamin C and chlorophyll (a, b and total) with increase in nitrogen dose from 100 kg/ha to 150 kg N/ha. On the contrary, the capsaicin content at N_1 and N_2 levels was at par and significantly higher than at N_3 level. According to Xiang et al. (2018), water stress and nitrogen stress are responsible for sub-optimal plant growth leading to low dry matter production. Increase in fruit chlorophyll content with increased nitrogen level may be ascribed to the fact that nitrogen is a main constituent of chloroplast which imparts green colour. The association of dry matter with capsaicin content (Fig. 2) shows that with increase in dry matter content, the capsaicin content in bell pepper fruits decreases. Similarly, enhancement in fruit capsaicin content is associated with a decrease in total fruit chlorophyll content (Fig. 3).

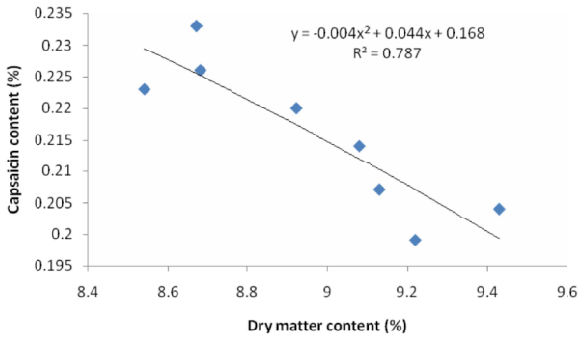

Figure 2: Relationship between capsaicin and dry matter content of bell pepper fruits

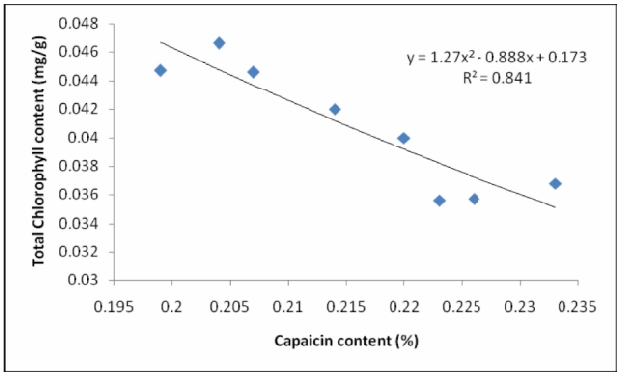

Figure 3: Relationship between capsaicin and total chlorophyll content of bell pepper fruits

Table 3: Quality parameters of bell pepper as influenced by nitrogen and irrigation levels under varying mulch conditions

Treatment	Dry matter (%)	Vitamin C (mg/100g)	Capsaicin (%)	Chlorophyll a (mg/g)	Chlorophyll b (mg/g)	Total chlorophyll (mg/g)
Mulching						
No mulch (M_0)	8.67	169.8	0.233	0.026	0.0112	0.0368
Paddy straw mulch @ 6t/ha (M_1)	9.22	181.6	0.199	0.029	0.0153	0.0447
CD (P=0.05)	0.45	4.4	0.020	0.003	0.0030	0.0061
Irrigation regime						
I_1 = (IW/CPE= 0.6)	8.68	169.5	0.226	0.024	0.0114	0.0357
I_2 = (IW/CPE= 0.9)	9.08	174.5	0.214	0.028	0.0137	0.0420
I_3 = (IW/CPE=1.2)	9.13	183.2	0.207	0.030	0.0148	0.0446
CD (P=0.05)	0.24	5.1	0.008	0.001	0.0008	0.0013
Nitrogen levels						
N_1 = 100 kg N/ha	8.54	164.1	0.223	0.025	0.0109	0.0356
N_2 = 125 kg N/ha	8.92	176.8	0.220	0.027	0.0132	0.0400
N_3 = 150 kg N/ha	9.43	186.2	0.204	0.031	0.0159	0.0466
CD (P=0.05)	0.20	4.1	0.010	0.001	0.0009	0.0149

Table 4: Soil properties (0-15 cm depth) as influenced by nitrogen and irrigation levels under varying mulch conditions after the final harvest of bell pepper

Treatment	pH	EC (dS/m)	OC (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Mulching						
No mulch (M_0)	8.41	0.145	0.265	103.6	13.08	362.4
Paddy straw mulch @ 6t/ha (M_1)	8.38	0.140	0.356	114.8	13.52	369.1
CD (P=0.05)	NS	0.001	0.017	1.2	0.43	1.4
Irrigation regime						
I_1 = (IW/CPE= 0.6)	8.37	0.142	0.285	105.0	13.18	361.4
I_2 = (IW/CPE= 0.9)	8.38	0.143	0.307	109.9	13.35	366.5
I_3 = (IW/CPE=1.2)	8.39	0.144	0.329	112.8	13.37	369.3
CD (P=0.05)	NS	NS	0.021	1.3	NS	NS
Nitrogen levels						
N_1 = 100 kg N/ha	8.38	0.141	0.294	106.9	13.24	359.4
N_2 = 125 kg N/ha	8.39	0.142	0.308	109.7	13.27	365.6
N_3 = 150 kg N/ha	8.39	0.143	0.329	111.2	13.40	372.2
CD (P=0.05)	NS	NS	0.015	2.4	NS	7.1

Soil properties: Mulching, irrigation regimes and N levels exerted non-significant effect on the pH of the surface soil (0-15 cm) (Table 4). The EC of soil decreased under M_1 than with M_0 because addition of PSM creates more binding sites for adsorption of cations and anions present in soil solution. On the contrary, the EC values were not significantly influenced by irrigation regimes and nitrogen levels. The OC content of soil increased from 0.265% under M_0 to 0.365% under M_1. This may be due to the addition of organic matter for four consecutive years by PSM. Under I_3 irrigation regime, 7.16% and 15.3% increase in OC was noticed over I_2 and I_1, respectively. The higher level of nitrogen (N_3) showed 6.82% and 11.90% increase in soil OC over N_2 and N_1 levels, respectively. The available N, P and K in soil increased with PSM application than under M_0. The various irrigation schedules non-significantly affected the available P and K content of soil, but available N content of soil increased under I_3 than under I_1 and I_2 levels.

The growth reduction at deficit irrigation may have resulted from less absorption of nutrients from soil and high irrigation level could compensate for it (Silber et al. 2003). The available N content increased under N_3 (150 kg N/ha) than N_1 (100 kg N/ ha) but was at par with N_2 (125 kg N/ha). Increasing the level of nitrogen will evidently increase the soil nitrogen content. The available K content also showed same trend. Qawasmi et al. (1999) have also reported the role of nitrogen in stimulating the plants uptake of potassium and phosphorous through its synergistic effect.

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सारांश

तीन सिंचाई स्तरों (आई$_1$ = 0.6, आई$_2$ = 0.9, आई$_2$ = 1.2) एवं तीन नत्रजन स्तरों (एन$_1$ = 100 किग्रा./हे., एन$_2$ = 125 किग्रा./हे., एन$_3$

= 150 किग्रा./हे.) के प्रभाव की जाँच के लिये विकास, उपज, गुणवत्ता और जल उपयोग दक्षता पर धान की पुआल, मल्चिंग ($एन_1$) के साथ शिमला मिर्च पर चार साल का अध्ययन किया गया। उल्लेखनीय रूप से अधिकतम फल उपज $आई_1$ एवं $आई_2$ स्तरों की तुना में अधिक संख्या में सिंचाई ($आई_3$) में दर्ज की गयी। फल उपज में $एम_0आई_3$ सांख्यिकीय रूप से $एम_0आइ_2$ के बराबर रहा, जिसमें धान पुआल मल्चिंग का उपयोग करके 50 किग्रा. नत्रजन प्रति हेक्टेयर बचाया जा सकता है। धान की पुआल मल्चिंग क्षेत्रों में कटाई उपरान्त फलों में शुष्क पदार्थ एस्कार्बिक अम्ल एवं क्लोरोफिल (ए. बी. एवं कुल क्लोरोफिल) बिना मल्चिंग क्षेत्रों की तुलना में अधिक थे, जबकि फलों में कैप्साइसिन मात्रा $एम_1$ क्षेत्रों की तुलना में अधिक थे, जबकि फलों में कैप्साइसिन मात्र $एम_1$ क्षेत्रों में पड़ती मृदा की तुलना में 14.6 प्रतिशत कम थी। फलों में शुष्क पदार्थ, विटामिन–सी एवं क्लोरोफिल (ए, बी और कुल क्लोरोफिल) $आई_1$ में सबसे कम और $आई_3$ में अधिकतम मात्रा में दर्ज किया गए थे, जबकि, कैप्साइसिन मात्रा में इसके विपरीत प्रवृत्ति का प्रदर्शन किया। नत्रजन की मात्रा 100 किग्रा./हे. से बढ़ाकर 150 किग्रा./हे. करने से फूलों में शुष्क पदार्थ, विटामिन–सी एवं क्लोरोफिल (ए, बी और कुल क्लोरोफिल) में वृद्धि और कैप्साइसिन मात्रा में कमी पायी गयी। $एम_1$ क्षेत्रों में जल उपयोग थोड़ा अधिक था जबकि, $एम_0$ क्षेत्रों की तुलना में $एम_1$ क्षेत्रों में जल उपयोग दक्षता और प्रोफाइल जल का उपयोग अधिक था। जल उपयोग और प्रोफाइल जल उपयोग में सिंचाई की बढ़ती आवृत्ति के साथ बढ़ती प्रवृत्ति का प्रदर्शन किया जबकि जल उपयोग दक्षता ने घटती प्रवृत्ति को दिखाया। जल उपयोग और जल उपयोग दक्षता $एन_3$ में सबसे कम पाया गया। सामान्यतः 1.0–1.5 सेमी. की सतह में जैविक कार्बन उपलब्ध नत्रजन, फास्फोरस और पोटैशियम की मात्रा धान की पुआल मल्चिंग के साथ पड़ती मृदा की तुलना में बढ़ जाती है।

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