

EFFECT OF PLANTING GEOMETRY AND MULCHING ON WATERMELON (*Citrullus lanatus* Thunb.) UNDER DRIP IRRIGATION

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ABSTRACT

A field experiment was conducted on heavy black soil at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during the summer 2011. The experiment results revealed that maximum growth and yield parameters along with profitable yield of watermelon can be obtained with paired row planting along with plastic mulch viz., black plastic or silver-black plastic mulch with drip irrigation than no mulch or sugarcane trash mulch or over surface method of irrigation.

KEY WORDS: Economics, Growth parameters, Watermelon

INTRODUCTION

Watermelon (*Citrullus lanatus* Thunb.) belongs to the family Cucurbitaceae, is a vine-like (scrambler and trailer) flowering plant. The hot and humid mountainous region of hilly tracts of western tribal belt of south Gujarat provide very characteristic agro-climatic conditions for production of watermelon and the farmers of these region cultivate watermelon as *kharif* and summer season crop every year.

Spacing is one of important agronomic variable which decide the size of fruit and yield per hectare in watermelon. Crop geometry and plant population plays an important role in obtaining higher yield. The watermelon gives high yield per plant and bigger sized fruits when the spacing is wide.

Mulching is the predominant act in inter-culture operation. Mulching primarily refers to that condition wherein the soil around the stem of a plant is covered from all sides in such a way that adequate moisture for growth is conserved, weeds do not grow and even the requisite normal temperature is maintained around the plant. The technique of mulching is generally, practiced by farmers using dry grass, dry leaves, sugarcane trash, saw dust, straw, hay, banana leaves, compost, etc. in their orchards/fields to conserve water existing in the soil. Of late, plastic mulch films have come in to use for the purpose of mulching due to its inherent advantages. Farmers are using different colored mulch material that are black, transparent, white, silver-black and silver/aluminum, red etc. The plastic

film mulching control weeds in two ways, transparent one act more on solarisation principle, the black film has been found to control the weeds mainly by preventing sunlight to the germinated weeds. It's not only results in increased crop yield, but also better quality of produce. Mulching also retains and maintains soil structure. Besides, the volume of plastic material to be used per unit area is much lesser than that of traditional mulch material. But the initial cost of plastic mulch is very high which increases the cost of cultivation.

Micro irrigation system, provide frequent application of water directly to soil surface near the root zone of plant, it deliver required and measured quantity of water in relatively small amount slowly to maintain the ideal moisture condition for growth. To irrigate vegetables and other closely spaced crops through drip irrigation system required assured water supply of discharge capacity of 4 liters per hour per dripper for one hectare for at least for 2-3 hours. These advantages of micro irrigation system are capable of resolving the excess and deficit water conditions being created in conventional method of irrigation.

Watermelon is becoming popular among the farmers of Gujarat because of its more remunerative than the existing crops. Presently, farmers are planting this crop at 2 × 1 m spacing under drip method of irrigation along with plastic mulching. For mulching, farmers are using imported two colour plastic (silver/black) and black plastic which are more costly than traditional sugarcane trash mulch. One way of reducing the cost of mulching is paired row planting. However, in South Gujarat, the information pertaining to this aspect is scanty. Keeping all these points in view, the present research work entitled "Effect of planting geometry and mulching on watermelon (*Citrullus lanatus* thunb.) under drip irrigation" was conducted.

MATERIALS AND METHODS

The field study was conducted on College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during summer 2011. Navsari falls under Agro-ecological situation-III of south Gujarat Heavy Rainfall Zone which is characterized by fairly warm summer. The investigation carried out with watermelon cv. Red honey. The experimental soil was clay in texture, low in available nitrogen (228 kg/ha), medium in available phosphorus (43 kg/ha), fairly rich in available potassium (524 kg/ha) and slightly alkaline in reaction (pH 7.8). For supplying N, P₂O₅ and K₂O as per treatments, urea, single super phosphate and muriate of potash, respectively of commercial grade were used. Of the recommended fertilizer dose of (150:75:75 NPK Kg/ha), 100 per cent P and 20 per cent N and K fertilizers were applied as basal. In control plots, remaining dose 80 per cent N and K was applied in two equal splits at 30 and 45 days after transplanting. In drip fertigation, 80 per cent N and K fertilizer were applied in 7 equal splits at weekly interval through fertilizer tank with calculated amount of urea and muriate of potash (white) at same time of irrigation. The treatments comprising of nine combinations of two planting geometries (G₁: Paired row planting and G₂: Normal planting) and four types of mulches (M₀: No mulch, M₁: Black plastic mulch, M₂: Silver-black plastic mulch and M₃: Sugarcane trash mulch) with drip method of irrigation as common treatment along with one control follows normal planting with surface irrigation and no mulch were tried in Factorial Randomized Block Design with three replications. The crop was managed as per the standard package of practices. The observations on growth parameters, yield attributes and yield were taken from the net plot. The data related to each parameters of the experiment

were statistically analyzed using MSTATC software. The purpose of analysis of variance was to determine the significant effect of treatments on watermelon. LSD test at 5% probability level was applied when analysis of variance showed significant effect for treatments (Steel and Torrie, 1980). The net realization was calculated by deducting the total cost of cultivation from the gross realization for each treatment.

RESULTS AND DISCUSSION

Influence on growth parameters of watermelon crop

Effect of geometry

Out of two planting geometries tried in the experiment, only normal row planting treatment influence the vine length of watermelon. Number of branches per vine was not affected significantly due to two planting geometries. The results are in consonance with those of Goreta *et al.* (2005), who measured the higher vine length with increase in spacing over lower plant spacing in watermelon. The similar results were also reported by Negi and Khurana (2003) in bitter gourd crop. Selvaraj and Natarajan (2000) observed that the wider spacing encourage the lateral growth of papino crop. An increase in vine length under wider spacing may be as results of greater exposure to light, leading to higher photosynthetic activity.

Effect of mulching

The watermelon crop grown by using the plastic mulches of two different colour (black and silver-black) recorded the vines of more length and more number of branches per vine than un-mulched plot and sugarcane trash mulch. The per cent increase in vine length under the silver black plastic mulch and black plastic mulch was 16.47 and 9.43 per cent as compared to no mulch treatment and these two mulches also had the more number of primary branches than un-mulched plot. Ferus *et al.* (2009) found

that black non-woven plastic mulch increases the vine length of watermelon crop. The increase in vine length due to use of mulch material as compared to no mulch was also reported by Korir *et al.* (2006) in cucumber and Ban *et al.* (2009) in watermelon. Similarly, Tan *et al.* (2009) also reported more number of primary branches in mulched plots of bottle gourd.

Drip along with the mulch used in watermelon crop recorded longer vine length and more number of primary branches as compared to control plot. Mulches markedly influenced light, temperature and moisture environment in the field (Ferus *et al.*, 2009).

Influence on yield attributes and yield of watermelon crop

Effect of geometry

The finding of present study pertaining to yield and yield parameters recorded at the time of harvest did not differ significantly due to geometry treatments. Hence, whatever the variation observed in yield attributes were only attributed to the mulching treatments.

Effect of mulching

Mulching with different material had significant effect on yield attributes and yield. However, average fruit weight did not differ significantly. The number of fruits per vine was significantly higher under black plastic (M₁) mulch which remained at par with silver-black plastic mulch (M₂). The lower number of fruits per vine was recorded with sugarcane trash and no mulch. Ekinci and Dursun (2009) also reported higher number of fruits under black plastic mulch in melon crop.

The silver-black plastic and black plastic mulch proved its superiority by increasing the watermelon yield over sugarcane trash mulch and no mulch treatment. These results substantiate the findings of White (2003), who found silver and black plastic mulch resulted in higher

yield. Shultsev (1975) and Laris and Santos (1997) also recorded higher yield under black plastic mulch as compared to no mulch application in watermelon crop. At SWMRU, NAU, Navsari, the higher yield of bitter gourd was obtained under black plastic mulch (Anonymous. 2002).

An increase in yield attributes and yield of watermelon might be due to optimum soil temperature, reduction in evaporation leading to higher soil moisture content and microbial activity resulted in more nutrient availability, suppressed weed growth and thus, reduced competition with crop (Shultsev, 1975).

Control vs. rest analysis showed the increase in number of fruits per vine and overall fruit yield with different treatments mean as compared to control with surface irrigation. The increase in yield attributes and yield of watermelon under different treatments could be due to use of drip irrigation under which water is applied strictly to the root zone drop by drop there by maintaining proper soil aeration which might have resulted to soil to remain soft and mellow for root proliferation so that maximum nutrient uptake by the plant leading higher fruit yield and attributing characters.

Influence on economics of watermelon crop

Effect of geometry

The differences were observed in the net income between paired row and normal planting as the former was superior over the later. The paired row planting have more income of Rs. 13,471/ha under black plastic and Rs. 12,121/ha under silver black plastic mulch over normal planting method. The increased income under paired row planting might be due to 50 per cent saving in the cost of laterals and mulch material needed for coverage the field in paired row planting over normal row planting.

Effect of mulching

Mulching is a key input for enhancing crop yield, but for its higher cost warrants its efficient use. It was with this purpose that the present mulching study was planned. The economics worked out in favour of plastic mulch, which with a net income of Rs. 1,34,664/ha and Rs. 1,28,343/ha stood first in order followed by sugarcane trash (Rs. 1,13,764/ha and Rs. 1,10,143/ha), no mulch (Rs. 1,10,314/ha and Rs. 1,17,543/ha). The lowest income was obtained under control plot (Rs. 94,415/ha). The only reason for increase in income under plastic mulches is the higher yield obtained under these two mulches as compared to no mulch and sugarcane trash mulch. The work carried out at Soil and Water Management Research Unit Navsari, (Anonymous 2002) in bitter gourd had resulted the net return of Rs.105.8 thousand/ha in drip with mulch and Rs.92.8 thousand/ha in surface without mulch treatment. Waterer (2000) also revealed reduced cost per unit fruit produced relative to the un-mulched control.

CONCLUSION

Based on the results of the field experimentation, it seems quite logical to conclude that maximum growth and yield parameters along with profitable yield of watermelon can be obtained with paired row planting along with plastic mulch viz., black plastic or silver-black plastic mulch with drip irrigation than no mulch or sugarcane trash mulch or over surface method of irrigation.

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Table 1: Effect of different treatments on length of vine and number of branches per vine of watermelon

Length of Vine (cm)				Number of Branches per Vine		
Treatments	G ₁	G ₂	Mean	G ₁	G ₂	Mean
M ₀	295.00	316.33	305.67	4.20	4.40	4.30
M ₁	327.67	341.33	334.50	5.73	6.87	6.30
M ₂	355.00	357.00	356.00	6.40	5.20	5.80
M ₃	312.00	306.00	309.00	4.53	4.53	4.53
Mean	322.42	330.17	326.29	5.22	5.25	5.23
Control	283.00			4.13		
	S.Em±	CD at 5%			S.Em±	CD at 5%
G	2.41	7.30			0.17	NS
M	3.40	10.32			0.25	0.74
G × M	4.81	NS			0.35	1.05
Cont vs. rest	3.59	10.77			0.27	0.80
CV %	2.6			11.5		

Table 2: Effect of different treatments on average fruit weight and number of fruits per vine in watermelon

Average fruit weight (kg)				Number of Fruits per Vine		
Treatments	G ₁	G ₂	Mean	G ₁	G ₂	Mean
M ₀	2.97	3.12	3.05	2.18	2.37	2.28
M ₁	2.56	2.59	2.58	2.99	2.61	2.80
M ₂	2.93	3.12	3.02	2.67	2.73	2.70
M ₃	3.12	2.69	2.90	2.21	2.20	2.20
Mean	2.90	2.88	2.89	2.51	2.48	2.49
Control	3.14			1.78		
	S.Em±	CD at 5%		S.Em±	CD at 5%	
G	0.144	NS		0.101	NS	
M	0.204	NS		0.143	0.432	
G×M	0.289	NS		0.202	NS	
Cont vs rest	0.207	NS		0.148	0.446	
CV%	17.3			14.0		

Table 3: Effect of different treatments on fruit yield of watermelon

Fruit yield (t/ha)			
Treatments	G ₁	G ₂	Mean
M ₀	28.41	30.33	29.37
M ₁	34.80	33.37	34.08
M ₂	37.48	36.31	36.89
M ₃	29.28	29.13	29.21
Mean	32.49	32.28	32.39
Control	24.99		
	S.Em. ±	CD at 5%	
G	0.816	NS	
M	1.154	3.501	
G×M	1.632	NS	
Cont vs rest	1.25	3.77	
CV %	8.7		

Table 4: Effect of different treatment combinations on fruit yield of watermelon

Treatments	Fruit yield (t/ha)
G ₁ M ₀	28.41
G ₁ M ₁	34.79
G ₁ M ₂	37.47
G ₁ M ₃	29.28
G ₂ M ₀	30.32
G ₂ M ₁	33.36
G ₂ M ₂	36.31
G ₂ M ₃	29.12
Control	24.98
S.Em.±	1.677
CD at 5 %	5.03
CV (%)	9.2

Table 5: Economics of different treatments

Sr. No.	Particulars	I ₁ (Pair Row)		I ₂ (Normal Row)		Control
		Black Plastic Mulch	Silver Black Plastic Mulch	Black Plastic Mulch	Silver Black Plastic Mulch	Surface
1	Fixed cost	5208	5208	7889	7889	1028
2	Variable cost	37528	37528	41168	41168	29457
3	Total cost (1+2)	42736	42736	49057	49057	30485
4	Yield (t/ha)	34.79	37.47	33.36	36.31	24.98
5	Income (Rs/ha)	173950	187350	166800	181550	124900
6	Net income (Rs/ha) (5-3)	131214	144614	117743	132493	94415
7	Water applied (mm)	394	394	394	394	560
8	Water saving (%)	29%	29%	29%	29%	-

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