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Influence of Planting Geometry and Mulching on Growth and Yield of Watermelon under Drip Irrigation

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Abstract—*The course of our agriculture development in India is determined to a great extent by how efficiently the water resources are utilized. A situation has come, where therein the utilization of every drop of water become indispensable to sustain the growth in agriculture production. In view of that, the present investigation having treatments with different types of planting geometry, three types of mulching material with control and surface control was planned and executed at the Soil and Water Management Research Unit (SWMRU) Farm, Navsari Agricultural University, Navsari during the summer season of year 2011-12, the results revealed that, treatment G_1 (Drip @ 0.6 PEF + Paired row planting of 1×0.80×3.2 m) recorded highest average fruit weight (2.90 kg), 2.51 fruits/ vine and fruit yield (32.49 t/ha) whereas, black plastic mulch of 50 micron (M_1) treatment produced highest number of branches per vine (6.30) and number of fruits per vine (2.80). The highest vine length (356.00 cm) and fruit yield (36.89 t/ha) was found with treatment black-Silver plastic mulch of 30 micron (M_2).*

Keywords: *drip irrigation, mulching, planting geometry and watermelon.*

1. INTRODUCTION

Watermelon (*Citrullus lanatus* Thunb.) contains about 6% sugar and 92% water by weight. As with many other fruits, it is a source of vitamin C. The amino acid citrulline was first extracted from watermelon and analyzed. Watermelon rinds, usually a light green or white color, are also edible and contains many hidden nutrients that most people avoid eating due to its unappealing flavour. Watermelon is also mildly diuretic and contains large amounts of beta carotene. Watermelon with red flesh is a significant source of lycopene. Watermelon is becoming popular among the farmers of because of its more remunerativeness than the existing crops.

The technique of mulching is generally, practiced by farmers using farm and animal wastes in their orchards/fields to conserve water existing in the soil. With the introduction of new synthetic plastics in late 60's, the role of mulches in vegetable production expanded considerably. Today, mulching done for conserve considerable amount of moisture which helps the crop to overcome moisture stress and results in higher yield. The plastic film mulching controls weed in two ways. While the transparent one acts more on solarisation principle, the black film has been found to control the weeds mainly by preventing the access of sunlight to the germinated weeds.

Mulching not only resulted in increased crop yield but also better quality of produce, retention and maintains soil structure. Further, the nutrient are in available from to the plant for a longer time during each wetting and drying cycle. In addition, it has been reported that in the microclimate condition of mulched plots, carbon dioxide concentration is more, favoring for higher photosynthesis. 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. So, present study is proposed in order to generate the information related to mulching and planting geometry of watermelon for reducing the cost of mulching in paired row planting.

2. MATERIALS AND METHODS

Present study was executed at the Soil and Water Management Research Unit (SWMRU) Farm, Navsari Agricultural University, Navsari during the summer season of year 2011-12. The treatments were made with different types of planting geometry *i.e.* Drip @ 0.6 PEF + Paired row planting of 1×0.80×3.2 m (G_1) and Drip @ 0.6 PEF + Normal row planting of 1×2 m (G_2), the three types of mulching material with control *viz.*, Black plastic mulch of 50 micron (M_1), Black-Silver plastic mulch of 30 micron (M_2), Sugarcane trash mulch @2 t/ha (M_3), no mulch (M_0) and surface control (1.0 IW/CPE ratio, Depth= 60 mm without mulch). Thus total nine treatment combinations including control were taken under the study and replicated thrice.

The mulches used in normal row planting with 35 per cent field coverage and that of paired row planting with 50 per cent

field coverage. In all the treatments the drip irrigation was common and in control plot surface irrigation was given. The drippers are placed at each plot in normal planting and in paired row planting the drippers are placed in between two plants of watermelon. Polyethylene sheets were well pressed with the soil to protect it from wind.

A common surface irrigation method was used to irrigate the control plot on the basis of cumulative pan evaporation. When it is 60 mm irrigation was given. The irrigation was applied through drip system on the basis of cumulative pan evaporation values, which were calculated from daily pan evaporimeter. The application time for each treatment of every irrigation was calculated using the following formula.

Operation time= F × CPE ×S/ r × n

Where,

F = Fraction of pan evaporation (%)

CPE = Cumulative pan evaporation on the date of irrigation

S = Size of plot (m^2)

r = Rate of discharge of an emitters (lph)

n = Number of emitters per plot

The irrigation time for paired row planting method was doubled from the time for normal row planting. Promising variety of watermelon *i.e.* Red honey was taken for investigation. To raise the crop recommended package of practices were followed. The different treatments were evaluated on the basis of growth, yield and quality performance. The various parameters were recorded from five randomly selected tagged vines and the mean data were subjected to statistical analysis.

3. RESULTS AND DISCUSSION

3.1 Growth parameters

The perusal of results presented in table 1 indicated that length of vine at harvest was influenced significantly due to individual effect of planting geometry and mulching. Normal row planted crop (G_2) recorded significantly longer vine length (330.17 cm) over paired row planted crop (322.42 cm). Crop mulched with silver-black plastic (M_2) recorded significantly higher longer vine length (356.00 cm) than rest of the mulching treatments. Control *vs* rest treatment analysis of vine length revealed that the vine length was significantly lower with control (283.00 cm) as compared with mean of treatments (326.29 cm). Better increase in vine length under wider spacing may be as result of greater exposure to light, leading to higher photosynthetic activity. The results are in consonance with those of Goreta *et al* (2005) in watermelon, Negi, *et al* (2003) in bitter gourd crop.

Table 1: Influence of planting geometry and mulching on growth and yield of watermelon under drip irrigation

Treatment	Length of vine (cm)	No of branches/ vine	Node number at which first fruit arises	Average fruit weight(kg)	No of fruits / vine	Fruit yield (t/ha)
GROWTH CONDITIONS						
G1	322.42	5.22	14.00	2.90	2.51	32.49
G2	330.17	5.25	14.77	2.88	2.48	32.28
S Em ±	2.41	0.17	0.34	0.144	0.101	0.816
CD at 5%	7.30	NS	NS	NS	NS	NS
MULCH						
M0	305.67	4.30	14.50	3.05	2.28	29.37
M1	334.50	6.30	15.33	2.58	2.80	34.08
M2	356.00	5.80	13.90	3.02	2.70	36.89
M3	309.00	4.53	13.80	2.90	2.20	29.21
S Em ±	3.40	0.25	0.48	0.204	0.143	1.154
CD at 5%	10.32	0.74	NS	NS	0.432	3.501
CONTROL	283.00	4.13	15.80	3.14	1.78	24.99
INTERACTION (G X F)						
S Em ±	4.81	0.35	0.68	0.289	0.202	1.632
CD at 5%	NS	1.05	NS	NS	NS	NS
CONTROL VS REST						
S Em ±	3.59	0.27	0.55	0.207	0.148	1.25
CD at 5%	10.77	0.80	NS	NS	0.446	3.77

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

The result of number of branches per plant were recorded at harvest of the crop and significantly maximum number of branches per plant was recorded with black plastic mulch M_1 (6.30) being at par with silver-black plastic mulch M_2 (5.80). The interaction G_2 M_1 (6.87) and G_1 M_2 (6.40) have significantly more number of branches per vine than rest of the combinations. Control *vs* rest analysis showed that the treatment mean recorded significantly higher branches per vine (5.23) than control (4.13). Planting geometry, mulching, interaction G×F as well as control *vs* rest treatment analysis could not influence significantly the node number at which first fruit arises.

Drip along with the mulch as common treatment applied in watermelon crop with longer vine length and more number of primary branches as compared to control plot. Shoot growth is the result of genotype traits and complex of physic-chemical

and biological soil and atmosphere characteristics. Mulches markedly influence light, temperature and moisture environment in the field (Ferus, *et al* 2009). However node number at which first fruit arises was not influence.

3.2 Yield attributes and yield

However the average fruit weight with paired row planting (G_1) as showed an edge over normal planting (G_2). It is apparent from the result in table-3 that mulching treatments failed to influence the average fruit weight. But numerically higher fruit weight of 3.05 kg was recorded with no mulch M_0 followed by M_2, M_3 and M_1.

The perusal of results presented in table 1 revealed that the effect of mulching was significant. Black plastic mulch recorded higher number of fruits per vine (2.80) which was at par with silver black plastic mulch (2.70). Control *vs* rest analysis furned out to be significant and control plot gave significantly lower fruits per vine (1.78) than treatment (2.49/vine). The all increased in yield attributes and yield might be due to optimum soil temperature, reduction in evaporation leading to higher soil moisture content and microbial activity results more nutrient availability, suppressed weed growth thus reduced competition with crop (Laris and Santos, 1997).

With respect to fruit yield, the data were subjected to statistical analysis by two method *viz.*, FRBD along with control *vs* rest and simple RBD. In FRBD analysis, only individual effect of mulching was found to be significant, but interaction effect of geometry and mulching showed non-significant effect on fruit yield (Table 1). However, numerically higher fruit yield of 32.49 t/ha was recorded with paired row planting (1×0.80×3.2 m) than normal planting (1×2 m) 32.28 t/ha. Among the different mulching treatments tried, silver black plastic mulch recorded significantly higher fruit yield 36.89 t/ha. However it remained at par with M1 (34.08 t/ha). An increase in yield with M_2 and M_1 was of the order of 25.6 and 16.0 per cent, respectively over control. The yield data analyzed by RBD presented in table 1 revealed that planting geometry and mulching combination with drip irrigation significantly increased the watermelon yield as compared to surface control (C). Among the different treatment combinations G_1 M_2 gave significantly higher yield (37.47 t/ha) and remained statistically at par with G_1 M_1, G2 M_1 and G_1 M_2. The increase in watermelon yield recorded with G_1M_2 was 50.0 over control.

The increase in yield attributes and yield under different treatments is due to use of drip irrigation under which water is applied strictly to the root zone drop by drop maintaining proper soil aeration which might have resulted to soil to remain soft and mellow for root proliferation so that maximum uptake of NPK by the plant resulting higher yield attributing characters, along with this it was benefited by mulch which might maintain optimum temperature, moisture and microbial activity resulting more nutrient availability (Sivanappan, 1979). These results substantiate the findings of White (2003) who found silver and black plastic mulch gave higher yield. Decoteau and Rhodes (1990), Laris and Santos (1997) recorded the highest yield under black plastic mulch as compared to no mulch application in watermelon crop.

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