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RESPONSE OF SQUASH MELON (*CITRULLUS VULGARIS VAR. FISTULOSUS*) TO FYM AND MULCHING UNDER RAINFED CONDITION OF HOT ARID REGION OF RAJASTHAN

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ABSTRACT

A field experiment was conducted at Central Arid Zone Research Institute, Regional Research Station , Bikaner during *Kharif* seasons of 2012 and 2013 on Squash Melon (*Tinda*) crop under rainfed conditions to evaluate four treatments of Farm Yard Manure *viz.*,0,20,30 and 40 t ha^{-1} and three treatment of mulching *viz.*, no mulch ,straw mulch and plastic mulch. Experiment was conducted in split – plot design with three replications using the *Tinda* cv. Selection 1. Vine length, numbers of fruits per plant and yield of squash melon (*Tinda*) crop were significantly influenced by FYM, mulching and their interaction during both the years of experiment. Application of FYM recorded significant improvement in yield up to 30 t ha^{-1}. Averaged across mulching, the yield with application of FYM @ 20, 30 and 40 t ha^{-1} had 43.3, 83.9 and 87.4 % higher yield compared to control. Application of mulch brought significant improvement in yield and its component. The straw mulch recorded highest vine length, numbers of fruits per plant and yield. Plastic and straw mulch had 24.80 and 42.25 % higher yield than no-mulch. The response of mulch varied with level of FYM application. The highest yield was recorded with application of 40 FYM t ha^{-1} combined with straw mulch, however the difference between FYM 30 t ha^{-1} and 40 t ha^{-1} was non-significant under both straw and plastic mulching.

Key words: Farm yard manure, Mulching, Rainfed, *Tinda*, Yield.

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INTRODUCTION

Squash melon commonly known as *Tinda* (*Citrullus vulgaris* var Fistulosus) belongs to family cucurbitaceae and is one of the most important rainfed vegetable grown in arid area of Rajasthan. It is rich in vitamin and minerals and possesses great medicinal value. The yield of *Tinda* in arid region is very low and unstable due to erratic and low rainfall and consequently the income from the crop is hardly sufficient to sustain the livelihood of farming community. The population density is growing up as a consequence the demands for nutritious agricultural products especially vegetable are increasing. This increasing demand can be fulfilled by improving the productivity of vegetable crops like *Tinda*, which are widely adapted to arid environment.

Use of organic material such as farm yard manures (FYM) is an important component in sustainable agricultural production in many countries (Kumar *et.al.*,1999). FYM promote sustainability due to it long term positive effect on chemical, physical and biological properties of soil (Sharma *et. al.*2010). General improvement in the crop yield and quality obtained when adequate rates of organic manures are incorporated in the soil. In addition to supply major and micronutrients, FYM also conserve soil moisture by improving physical properties.

In the arid areas retention of the soil moisture and supply of nutrient is a big challenge. The use of mulch can help prove full in conservation of moisture. The effectiveness of mulches for moisture conservation has varied, depending upon the soil, climate, crop, type of material used and the degree

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of cover on soil. In coarse textured soils, the surface 10-cm layer is granular, dry aggregates of size more than 2 mm are hardly one percent, capillarity is almost nil, pore discontinuities are predominant and hydraulic conductivity is high. Added water thus moves down at a rapid rate and is placed deep in the profile and its upward flow is very slow as a result, the evaporative site dries up quickly and the thermal contact co-efficient is reduced. In order to mitigate the adverse effect of water stress in water scarcity areas, in-situ water conservation through mulches have been found to conserve soil moisture, control weeds, moderate soil temperature and increase yield of different vegetable crops. Kumar and Bhardwaj (2012) also reported that mulch checks evaporation and modifies the soil and air microclimate in which a plant is growing. Mulch is used to cover soil surface around the plants to create congenial condition for the growth. This may include temperature moderation, salinity and weed control. It exerts decisive effects on earliness, yield and quality of the crop. It is preferred in fruit orchard, flower and vegetable production, nurseries and forest where frequent cultivation is not required for raising the crops. Most commonly used agricultural mulch is black plastic. Weed control beneath the mulch is a deterrent to its use. Therefore, it is also necessary to evaluate mulching materials like polyethylene and organic material like straw available with the farmer in the western Rajasthan.

Therefore, the present investigations were undertaken to study the effect of different levels of farm yard manure with and without mulch on growth and yield of *Tinda* under rainfed situation of the arid area of Rajasthan.

MATERIALS AND METHODS

The experiment was conducted at Central Arid Zone Research Institute, Regional Research Station, Bikaner, Rajasthan (28°4' N; 74°3' E and 238.3 m above mean sea level) during *Kharif* seasons of 2012 and 2013. The soil of the field was loamy sand, low in organic carbon and high in available potassium and had pH 8.1, electrical conductivity 0.2 ds m^{-1} with field capacity of 7.8% geometric and volume by volume is 11.8% and permanent wilting point is 3.0%. In arid areas of Rajasthan the rains are erratic and mainly occur in the month of July–September (Fig.1). According to onset of rainfall during 2012 *kharif* crop was sown on 11.08.2012 and during 2013 *kharif* was sown on 22.07.2013.

Experiment included four treatments of Farm Yard Manure *viz.*,0 t ha^{-1} (F_1), 20 t ha^{-1} (F_2), 30 t ha^{-1} (F_3), and 40 t ha^{-1} (F_4) and three treatment of mulching *viz.*, no mulch (M_1) ,straw mulch (M_2) *viz.* unused straw/grasses @ 10 t ha^{-1} and plastic mulch (M_3) *viz.* black polyethylene-of 25 micron thickness. Experiment was conducted in split plot design with dose of FYM in main plot and mulching in subplot replicated thrice. The cultivar Selection-1 comprised

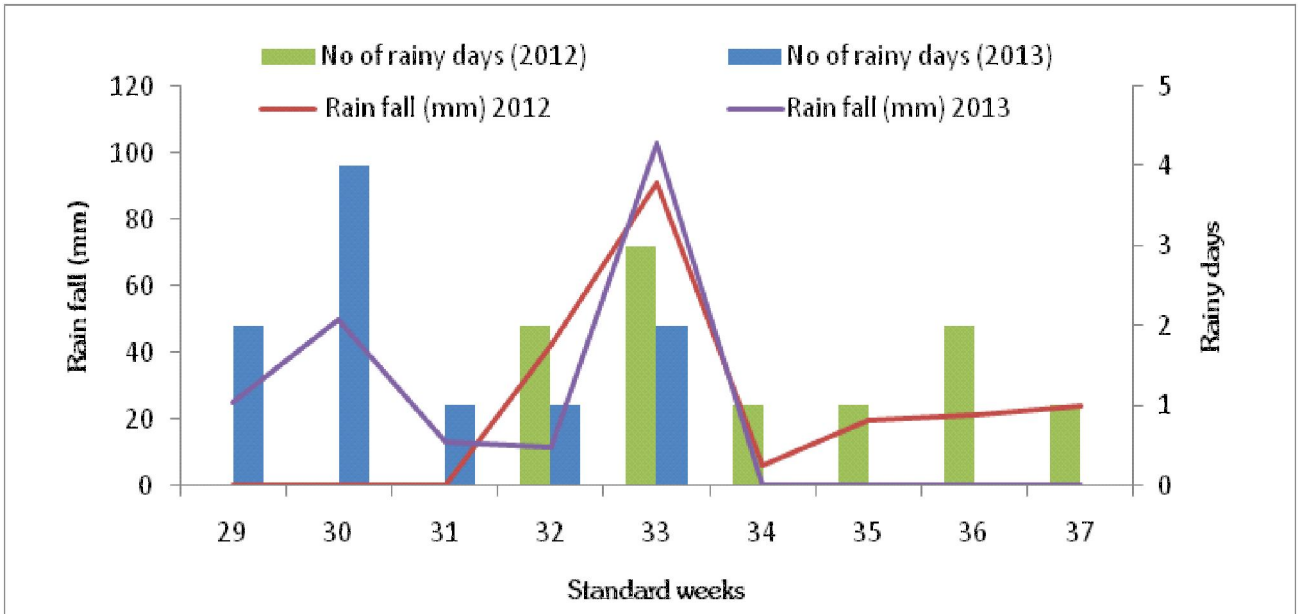

FIGURE 1: Rainfall pattern during crop seasons.

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seed material and sown at 0.6 m x 1.0 m spacing in 4.0 m × 4.0 m sized plots. Growth and yield attributes were measured from ten randomly selected plants from each plot excluding border rows.

Analysis of variance of the experimental data was carried out as suggested by Gomez and Gomez (1983). When the *F*-test was significant ($P< 0.05$), the means were compared using the least significant difference (LSD) test at P= 0.05.

RESULTS AND DISCUSSION

Farm Yard Manure (FYM) and mulching material and their interaction had non-significant response on days taken to germination and to appear first flower during both years (Table 1). Whereas, vine length showed significant response to FYM, mulching and their interaction (F X M) measured at harvest in both the years. Maximum vine length was recorded under 40 t ha^{-1} FYM treatment which was significantly superior to all other treatment of the FYM. It was due to the favourable effect of FYM in moisture retention in soil for longer duration and supply of essential nutrients to the crop. Among the different mulching material straw mulch improved the vine length significantly followed by plastic and no mulching treatments. The interaction effect of FYM and Mulching was significant for vine length and the tallest vine was recorded with F_4M_2 followed by F_3M_2 and F_4M_3 treatment combination .The increase in vine length was might be due to positive effect of straw mulch in moisture conservation and favourable temperature in the root zone of the crop (Singh, 2005).

The individual treatment of FYM and mulching did not show the significant response on fruit weight but interaction effect of FYM and Mulching was found significant for fruit weight (Table 2). The maximum fruit weight was recorded under F_4M_2 followed by F_3M_3, F_4M_3 and F_2M_1. The picking of the green fruits of *Tinda* was done on three days interval thus the individual treatment could not show the significant effect whereas the treatment which have higher nutrient as well as mulch treatment they responded significant only.

Numbers of fruits per plant of *Tinda* crop were significantly influenced by FYM, mulching and their interaction during both the years of experiment. The FYM @40 t ha^{-1} (F_4) had higher number of fruits per plant in both the years with mean number of fruits per plant across the mulching treatment and years was 12.80 which was statistically at par with

TABLE 1: Effect of FYM and mulching on growth attributes of *Tinda* under rainfed condition.

Treatments	Days taken to germination			Days taken to 1st flower			Vine length(cm)		
	2012	2013	Pooled	2012	2013	Pooled	2012	2013	Pooled
FYM									
0 t ha^{-1} (F_1)	6.78	6.89	6.83	30.78	30.00	30.39	89.56	107.11	98.33
20 t ha^{-1} (F_2)	6.67	6.56	6.61	29.22	29.00	29.11	135.56	156.56	146.06
30 t ha^{-1} (F_3)	6.56	6.44	6.50	26.56	26.33	26.44	170.33	201.44	185.89
40 t ha^{-1} (F4)	5.22	5.56	5.67	24.78	23.78	24.28	199.11	215.33	207.22
LSD (P= 0.05)	NS	NS	NS	3.84	4.10	3.67	17.9	29.87	21.15
Mulching									
No Mulch(M_1)	6.67	6.75	6.71	30.17	29.75	29.96	112.58	122.83	117.71
Straw mulch(M_2)	6.25	6.33	6.38	26.67	26.42	26.54	188.50	211.83	200.17
Plastic mulch(M_3)	6.00	6.00	6.13	26.67	25.67	26.17	144.83	175.67	160.25
LSD (P= 0.05)	NS	NS	NS	2.70	2.06	2.20	9.8	10.75	7.20
FYM X Mulching									
F_1M_1	7.33	7.33	7.33	34.33	34.33	34.33	71.67	76.00	73.83
F_1M_2	6.67	6.67	6.67	29.33	28.33	28.83	111.67	133.33	122.50
F_1M_3	6.33	6.67	6.50	28.67	27.33	28.00	85.33	112.00	98.67
F_2M_1	6.67	6.67	6.67	30.00	30.33	30.17	99.67	107.67	103.67
F_2M_2	7.00	6.67	6.83	29.00	30.00	29.50	173.67	190.00	181.83
F_2M_3	6.33	6.33	6.33	28.67	26.67	27.67	133.33	172.00	152.67
F_3M_1	6.67	6.33	6.50	27.33	27.67	27.50	123.33	146.67	135.00
F_3M_2	6.33	7.00	6.67	26.00	25.67	25.83	223.33	256.33	239.83
F_3M_3	6.67	6.00	6.33	26.33	25.67	26.00	164.33	201.33	182.83
F_4M_1	6.00	6.67	6.33	29.00	26.67	27.83	155.67	161.00	158.33
F_4M_2	5.00	5.00	5.33	22.33	21.67	22.00	245.33	267.67	256.50
F_4M_3	4.67	5.00	5.33	23.00	23.00	23.00	196.33	217.33	206.83
LSD (P= 0.05)	NS	NS	NS	5.17	3.95	4.21	18.7	20.60	13.80

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TABLE 2: Effect of FYM and mulching on yield attributes and yield of *Tinda* under rainfed condition.

Treatments	Fruit weight(g)			Number of fruits per plant			Yield (q/ha)		
	2012	2013	Pooled	2012	2013	Pooled	2012	2013	Pooled
FYM									
0 t ha^{-1} (F_1)	36.42	36.93	36.68	7.04	7.37	7.21	84.42	85.33	84.88
20 t ha^{-1} (F_2)	37.54	40.96	39.25	9.36	11.27	10.31	115.46	136.33	125.90
30 t ha^{-1} (F_3)	38.53	41.69	40.11	10.98	13.87	12.42	139.66	172.67	156.16
40 t ha^{-1}(F4)	38.71	45.06	41.88	11.16	14.44	12.80	141.43	176.78	159.10
LSD (P= 0.05)	NS	NS	NS	1.87	1.73	1.65	12.75	23.04	16.03
Mulching									
No Mulch(M_1)	36.87	39.66	38.26	8.73	9.44	9.09	106.63	108.33	107.48
Straw mulch(M_2)	38.52	41.97	40.24	10.33	14.15	12.24	131.22	174.58	152.90
Plastic mulch(M_3)	38.03	41.84	39.93	9.83	11.62	10.73	122.87	145.42	134.14
LSD (P= 0.05)	NS	NS	NS	0.52	0.80	0.42	5.29	6.93	5.17
FYM X Mulching									
F_1M_1	34.80	32.67	33.73	5.33	4.44	4.89	60.60	51.00	55.80
F_1M_2	37.93	37.88	37.91	7.73	9.10	8.41	96.41	107.67	102.04
F_1M_3	36.53	40.23	38.38	8.07	8.57	8.32	96.25	97.33	96.79
F_2M_1	37.03	44.07	40.55	8.27	8.71	8.49	100.79	107.00	103.90
F_2M_2	38.00	38.42	38.21	10.07	13.63	11.85	125.01	164.67	144.84
F_2M_3	37.60	40.40	39.00	9.73	11.47	10.60	120.58	137.33	128.96
F_3M_1	37.67	39.88	38.78	10.13	11.58	10.86	124.93	136.00	130.46
F_3M_2	39.13	40.88	40.01	11.67	16.90	14.28	153.19	207.33	180.26
F_3M_3	38.80	44.30	41.55	11.13	13.12	12.13	140.85	174.67	157.76
F_4M_1	37.97	42.03	40.00	11.20	13.03	12.12	140.2	139.33	139.77
F_4M_2	39.00	50.70	44.85	11.87	16.96	14.41	150.28	218.67	184.48
F_4M_3	39.17	42.43	40.85	10.40	13.33	11.87	133.81	172.33	153.07
LSD (P= 0.05)	3.39	11.16	6.34	1.01	1.54	0.82	10.13	13.28	9.91

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FYM 30 t ha^{-1} (F_3). Mulching increased the number of fruit per plant significantly in both the years. Among different mulching materials, straw mulch showed the significant higher fruit per plant over plastic and no mulch treatment. The interaction effect of FYM and mulching was significant for number of fruits per plant. The highest number was recorded with higher dose of FYM with straw mulch which was statistically at par with F_3M_2 during both the year of study. This might be due to that the tendrils of the vine were tied with straw and resulted less flower and fruit dropping due to wind. Similarly, results reported by Singh *et.al.*(2007) in field pea with mulching and FYM indicated that mulching and FYM conserved maximum soil moisture accompanied with highest reduction in soil temperature and produced highest pod yield per plot, number of seeds per pod, pod length, number of pods per plant, number of branches per plant and plant height of field pea.

Fruit yield (q ha^{-1}) of *Tinda* was significantly increased by various treatments viz FYM, mulching and their interaction during both the years of experimentation. Higher dose of FYM showed superiority over all treatment of the FYM but statistically at par with dose of 30 t ha1 (F3). Improvement in yield per hectare in pooled data of both the years was 87.4 %, 83.9% and 43.3% higher over control by F4, F3 and F2 treatments, respectively (Table 2). Among the different mulching materials, the straw mulch gave the highest fruit yield in both years. The fruit yield with straw mulch attained 13.79 and 42.25 higher compared to plastic and no mulch respectively. Anuja and Archana (2012) found that application of organic nutrients like FYM @ 25 t ha^{-1} increased the yield of bittergourd. Saravaiya, *et.al.*(2012) also found that to obtain higher fruit yield of pointed gourd under INM system the vine should be fertilized with the combination of 50 percent RDF along with 10 t ha^{-1} of bio-compost. Tüzel, *et.al.*(2007) conducted a study in order to elucidate the problems in organic greenhouse cucumber growing. Two rates of farmyard manure (15 or 30 t ha^{-1}) were tested during autumn and spring seasons of 2003 and 2004 in Turkey using cultivar Sardes. Higher yield was obtained in the farmyard manure application of 15 ton ha^{-1} (5.92 kg m^{-2}) compared to the application of 30 t ha^{-1} (3.95 kg m^{-2}) in autumn season, whereas higher total yield (17.84 kg m^{-2}) was obtained from

the plants grown by the application of 30 t ha^{-1} farmyard manure in spring. Yadav and Choudhary (2012) used three types of mulching viz., no mulch, kheep @ 10 t ha^{-1} as organic mulch and black polyethylene (25 micron) in tomato and reported that organic mulch registered the significantly highest plant growth, yield attributes and fruit yield (832.1q ha^{-1}). The maximum net returns (282536ha^{-1}) and B:C ratio (2.1) of different mulches was recorded with organic mulch. Similarly Choudhary et. al. (2012) also reported favorable effect of organic mulch in okra.

The interaction was significantly for fruit yield in both the years. The fruit yield per hectare under different combination of FYM and mulching ranged from 60.60-153.19 q ha^{-1} in 2012 and 51.00-218.33q ha^{-1} in 2013 .The FYM @40 t ha^{-1} with straw mulching recorded the highest fruit yield in pooled of the data which statistically at par with FYM 30 t ha^{-1}. Kumar and Bhardwaj (2012) reviewed that in water deficit area (rainfed area), judicious use of water is essential for increasing area under crop production with limited water supply. Mulching has been advocated as an effective means for conserving soil moisture. It works as an insulating barrier which checks evaporation from soil surface. It is very useful in protecting the roots of the plants from heat, cold or drought or to keep fruit clean. It checks evaporation and modifies the soil and air microclimate in which a plant is growing. Mulch is used to cover soil surface around the plants to create congenial condition for the growth. This may include temperature moderation, salinity and weed control. It exerts decisive effects on earliness, yield and quality of the crop.

CONCLUSION

‘ From the present study, it may be concluded that application of FYM @ 30 t ha^{-1} along with straw mulch was beneficial in improving productivity of *Tinda* under rainfed conditions through their beneficial effect on physical, chemical and biological properties of soil and improvement in microclimate besides moisture conservation.

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