Impact of soil moisture status, mulching and spacing on yield and water productivity in irrigated Elephant foot yam (*Amorphophalluspaeoniifolius*)

ABSTRACT

Aims: To standardize crop spacing and irrigation requirements under different mulching situation for better yield and water productivity.
Study design: The experiment was designed in factorial RBD with two replications.
Place and Duration of Study: The experiment was conducted for three consecutive years during 2016 to 2019 at Agronomic Research Station, Kerala Agriculture University (KAU), Chalakudy.
Methodology: Study conducted with 18 treatments, includes three levels of irrigation, three types of mulching and with two different crop spacing.Observations on weed count and weed dry matter production were also taken to study the effect of different mulches on weed growth. Biometric observations of crop growth and yield were recorded.
Results: Observations on biometric characters revealed that both the height and diameter of the crop canopy were significantly influenced by mulching and found to be highest in the plot where leaf was used as the mulching material and the yield of *Amorphophallus* during 2016 - 2017 showed that corm weight was greatly influenced by irrigation levels, mulching and spacing. Corm yield was lowest in the plot where irrigation frequency was once in three days (21.02 t/ha). Yield in leaf mulched plot was 38.11 t/ha while in plastic mulched and no mulched plots were 23.50 and 19.50 t/ha. Effect of treatments on water productivity and BC ratio showed that leaf mulching of the crop has significant effect. In leaf mulched plot, water productivity in 2016-17 was 2.03 while it was only 1.854 and 0.886 in 2017-18 and 2018-19. Similarly, BC ratio was highest for leaf mulched plot followed by no mulch and plastic mulch plot.
Conclusion:*Amorphophallus* planted at a spacing of 90 cm x 90 cm, irrigated at a frequency of once in three days along with leaf mulching can increase the yield and water productivity along with effective control of weed population.

Keywords:Amorphophallus, drip irrigation, mulch, agronomic practices

1. INTRODUCTION

Amorphophalluspaeoniifolius (Dennst.) Nicolson, known as the "king of tuber crops," or elephant foot yam, is a tropical and subtropical tuber crop grown as pure crop or inter crop (Reddy et al. 2023). Due to its increased yield, widespread use as a vegetable and therapeutic qualities, the crop has been evolved into a cash crop in modern times (Khare 2007). In India, elephant foot yam is widely grown across several states including Andhra Pradesh, West Bengal, Gujarat, Kerala, Tamil Nadu, Maharashtra, Uttar Pradesh, and Jharkhand (Ravi et al. 2009) covering an area of 40,000 ha with a production of 1.0 million metric tonnes (NHB 2022). Generally, in Kerala, it is grown as a rainfed crop, planted one month before the onset of monsoon (February-March), and harvested by December.

Comment [a1]: Can you change title to Optimizing Soil Moisture, Mulching, and Spacing for Yield and Water Productivity in Irrigated Elephant Foot Yam (Amorphophallus paeoniifolius).

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However, cultivating *Amorphophallus* as an irrigated crop is the only way to meet the demand during the Onam festival season.

Weeds are the major constraint for both yield and quality in *Amorphophallus* cultivation (Suresh et al. 2020b). The first five months after planting are the crucial stage in *Amorphophallus* characterized by intense crop weed competition due to significant crop growth and corm bulking (30 to 90 days for bud development, sprouting, and canopy expansion) (Sunitha et al. 2018). Weed infestation during this critical period can lead to substantial yield losses, potentially reaching up to 100% (Suresh et al. 2020a). An integrated weed management approach is necessary to protect the crop from weed for the first five months. Primarily mulching techniques are used in fields to manage weed growth. The selection of proper mulch depends on factors such as the specific types of weeds, soil characteristics, terrain, local weather conditions, crop type and the availability of mulching materials (Chopra et al. 2020). Along with weed control efficiency, mulching also has water and soil conservation properties (Patil et al. 2013). Thus, this study also focuses on the effect of different mulches on water conservation efficiency, weed control efficiency and productivity of *Amorphophallus*.

Survey about the cultivation practices followed by farmers showed that many fungal diseases are associated with unscientific irrigation practices, hence there is a need for the standardization of irrigation practices. Compared to normal cultivation of *Amorphophallus*, the crop duration of irrigated *Amorphophallus* is much shorter, thus standardization of crop spacing also needs to be done to achieve profitable yields. Standardization of crop spacing and irrigation requirements under different mulching situations were the major objectives of the study.Provide a factual background, clearly defined problem, proposed solution, a brief literature survey and the scope and justification of the work done.]

2. MATERIAL AND METHODS

The experiment was conducted for three consecutive years during 2016 to 2019 at Agronomic Research Station, Kerala Agriculture University (KAU), Chalakudy (10.3116° N, 76.3419° E). The experiment was designed in factorial RBD with two replications and the treatment details aregiven in Table 1.

Comment [a6]: Rabi 2016-17 to 2018-19

Table 1. Experimental treatments

Treatments	
Irrigation levels – 3 Nos	
I_1	Drip irrigation- daily
I_2	Drip irrigation- once in two days
I_3	Drip irrigation- once in three days
Crop spacing – 2 Nos	
S_1	75 cm x 75 cm
S_2	90 cm x 90 cm
Mulching- 3 types	
M_1	No mulch
M_2	Plastic mulch
M_3	Leaf mulch

Seed tubers of Amorphophallus var. Wayanad local weighing one kg were planted in a plot of dimension 4.5 m x 3 m as per the recommended practices of KAU during the last week of December 2016. Drip irrigation system was installed with dripper discharge of 4 litres per hour and irrigation was done as per the treatments. Observations on soil moisture content and soil temperature were recorded. During the crop growth three weedings were done. Observations on weed count and weed dry matter production were also taken to study the effect of different mulches on weed growth. Biometric observations of crop growth and yield were recorded. Harvesting was done eight months after planting (MAP). The experimental trial was repeated for 2017 – 2018 and 2018 - 2019 for obtaining refined results.

3. RESULTS AND DISCUSSION

Observations on biometric characters revealed that both the height and diameter of the crop canopy were significantly influenced by mulching and found to be highest in the plot where leaf was used as the mulching material (Table 2). Germination per cent of the corm pieces were also affected by the type of mulching material. It was highest in leaf mulched plot (100%) followed by plastic mulch (90.4%) and no mulch (75%) (Fig. 1).The study conducted by Dong et al. (2016) also shows the same result that in a mulched condition, the aerial parts of the plants were developed very well and the leaf surface area was also increased which promotes the overall assimilation process. A similar study was conducted by Mathew et al. (1988) on response of amorphophallus to irrigation and mulching and inferred that the height and canopy radius of the corm were strongly influenced by mulching. In the study of Ghimire et al. (2021) canopy diameter among different mulching materials were compared and observed highest with plastic mulches to that of straw mulch.

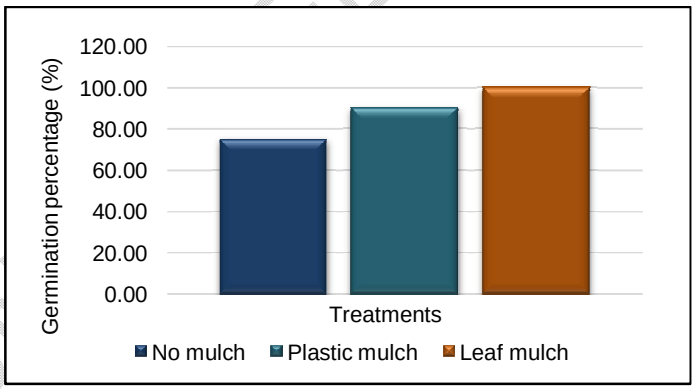

Fig. 1.Germination percent of corm pieces under different mulching conditions (%).

Table 2. Effect of treatments on growth of *Amorphophallus* in 2018 – 2019

Treatment	Height of plant	Diameter of plant

	(cm)	(cm)
Irrigation levels (I)		
Daily (I_1)	37.01	79.25
Alternate days (I_2)	35.3	74.74
Once in 3 days (I_3)	35.93	70.19
CD (0.05)	NS	NS
Mulching (M)		
No Mulch- M_1	31.47	67.33
Plastic Mulch- M_2	31.97	64.91
Leaf Mulch- M_3	44.8	91.94
CD (0.05)	7.66	16.36
Spacing (S)		
S_1- 75 X 75 cm	37.09	74.68
S_2 90 X 90 cm	35.07	74.77
CD (0.05)	NS	NS
I X M		
I_1 X M_1	36.08	76.41
I_1 X M_2	31.12	66.75
I_1 X M_3	43.83	94.58
I_2 X M_1	28.74	68.5
I_2 X M_2	32.41	62
I_2 X M_3	44.75	93.74
I_3 X M_1	29.58	57.08
I_3 X M_2	32.37	66
I_3 X M_3	45.83	87.5
CD (0.05)	NS	NS
I X S		
I_1 X S_1	38.27	80.72
I_1 X S_2	35.75	77.77
I_2 X S_1	36.38	74.33
I_2 X S_2	34.22	75.16
I_3 X S_1	36.61	69
I_3 X S_2	35.24	71.38
CD (0.05)	NS	NS
M X S		
M_1 X S_1	32.55	67.77
M1X S2	30.38	66.88
M_2 X S_1	33.55	67.61
M_2 X S_2	30.38	62.22
M_3 X S_1	45.16	88.66
M_3 X S_2	44.44	95.22
CD (0.05)	NS	NS
I X M X S		
I_1 X M_1 X S_1	40	83.33
I_1 X M_1 X S_2	32.16	69.5
I_1 X M_2 X S_1	36.16	75.33
I_1 X M_2 X S_2	26.08	58.16
I_1 X M_3 X S_1	38.66	83.5
I_1 X M_3 X S_2	49	105.66
I_2 X M_1 X S_1	27.83	64.66
I_2 X M_1 X S_2	29.66	72.33

I_2 X M_2 X S_1	29.16	57.5
I_2 X M_2 X S_2	35.66	66.5
I_2 X M_3 X S_1	52.16	100.83
I_3 X M_3 X S_2	37.33	86.66
I_3 X M_1 X S_1	29.83	55.33
I_3 X M_1 X S_2	29.33	58.83
I_3 X M_2 X S_1	35.33	70
I_3 X M_2 X S_2	29.41	62
I_3 X M_3 X S_1	44.67	81.66
I_3 X M_3 X S_2	47	93.33
CD (0.05)	NS	NS

Results of the study revealed that weed infestation in the plot was influenced by irrigation levels, mulching and spacing (Table 3). Weed count and weed dry matter production was highest in once in 3 days irrigated plot followed by alternate day and daily irrigated plot. There was significant difference between the various mulching treatments on weed infestation. Under plastic mulching situation weed infestation was lowest and it was highest in no mulched plot. Spacing did not influence weed infestation. Asadi et al. (2019) conducted a study on effect of irrigation on dry matter production of different weeds and reported that while increasing the irrigation intervals, the dry matter content in the weed decreases significantly hence, weed dry matter production is influenced by irrigation. Laurie et al. (2015) showed that mulching was very useful to control weeds than the other methods and have a significant influence on weed management.

Table 3. Effect of treatments on weed infestation in the experiment plot (6 sq.m)

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Treatment	Weed count (No.) 2 MAP*	Dry matter production (g) 2 MAP	Weed count (No.) 6 MAP	Dry matter production (kg) 6 MAP
Irrigation levels (I)				
Daily (I_1)	69.16	106.93	143.25	0.55
Alternate days (I_2)	99.58	85.53	138.58	0.56
Once in 3 days (I_3)	110.70	127.65	158.83	0.66
CD (0.05)	**NS**	**NS**	**NS**	**NS**
Mulching (M)				
No Mulch- M_1	157.79	164.03	163.50	0.64
Plastic Mulch- M_2	29.16	22.87	152.16	0.63
Leaf Mulch- M_3	92.50	133.20	125.00	0.49
CD (0.05)	**43.84**	**54.05**	**NS**	**NS**
Spacing (S)				
S_1- 75 X 75 cm	105.44	94.72	109.00	0.43
S_2 90 X 90 cm	80.86	118.68	184.77	0.74
CD (0.05)	**NS**	**NS**	**NS**	**NS**
I x M				
I_1 X M_1	108.00	148.00	159.50	0.67
I_1 X M_2	23.25	11.84	93.00	0.31
I_1 X M_3	76.25	160.95	177.25	0.66
I_2 X M_1	173.25	141.52	92.00	0.31
I_2 X M_2	27.25	6.84	155.00	0.65
I_2 X M_3	98.25	108.22	168.75	0.71
I_3 X M_1	192.12	202.57	239.00	0.95
I_3 X M_2	37.00	49.95	208.50	0.94

I_3 X M_3	103.00	130.42	29.00	0.10
CD (0.05)	NS	NS	NS	NS
		I x S		
I_1 X S_1	70.83	111.74	102.83	0.32
I_1 X S_2	67.50	102.12	183.66	0.77
I_2 X S_1	123.00	63.27	97.33	0.44
I_2 X S_2	76.16	107.79	179.83	0.67
I_3 X S_1	122.50	109.15	126.83	0.54
I_3 X S_2	98.91	146.15	190.83	0.78
CD (0.05)	NS	NS	NS	NS
		M x S		
M_1 X S_1	206.00	163.41	126.50	0.47
M1X S2	109.58	164.65	200.50	0.81
M_2 X S_1	32.33	11.59	108.00	0.47
M_2 X S_2	26.00	34.16	196.33	0.80
M_3 X S_1	78.00	109.15	92.50	0.36
M_3 X S_2	107.00	157.25	157.50	0.62
CD (0.05)	62.01	NS	NS	NS
		I x M x S		
I_1 X M_1 X S_1	119.00	140.60	151.50	0.64
I_1 X M_1 X S_2	97.00	155.40	167.50	0.70
I_1 X M_2 X S_1	15.00	17.02	43.50	0.03
I_1 X M_2 X S_2	31.50	6.66	142.50	0.60
I_1 X M_3 X S_1	78.50	177.60	113.50	0.30
I_1 X M_3 X S_2	74.00	144.30	241.00	1.02
I_2 X M_1 X S_1	232.50	105.45	94.00	0.32
I_2 X M_1 X S_2	114.00	177.60	90.00	0.29
I_2 X M_2 X S_1	33.00	6.66	65.50	0.39
I_2 X M_2 X S_2	21.50	7.03	244.50	0.92
I_2 X M_3 X S_1	103.50	77.70	132.50	0.61
I_3 X M_3 X S_2	93.00	138.75	205.00	0.81
I_3 X M_1 X S_1	266.50	244.20	134.00	0.46
I_3 X M_1 X S_2	117.75	160.95	344.00	1.44
I_3 X M_2 X S_1	49.00	11.10	215.00	0.98
I_3 X M_2 X S_2	25.00	88.80	202.00	0.89
I_3 X M_3 X S_1	52.00	72.15	31.50	0.18
I_3 X M_3 X S_2	154.00	188.70	26.50	0.02
CD (0.05)	NS	NS	NS	NS

*MAP = Months after planting

Soil temperature and soil moisture of the field varied under different mulching conditions. Results on pooled analysis of the data for three years is given in the Table 4. Soil temperature was lowest in leaf mulched plot compared to plastic mulched and no mulched plot. Soil moisture content was highest in plastic mulched and lowest in no mulched plot. Mbagwu (1991) conducted a study on influence of different mulch materials on soil temperature, soil water content and yield of three cassava cultivars and concluded that maximum daily soil temperature was retained by polythene mulching especially black polythene mulch and lowest temperature was observed in the plot in which straw mulching was done which support the results of this study. This is in accordance with findings of Gurnah and Mutea (1982); Manrique and Meyer (1984); Triathi and Katiyar (1984).

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Table 4. Effect of treatments on soil temperature and moisture in *Amorphophallus* during 2018.

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Treatment	Soil moisture (%)	Soil Temperature (℃)
Irrigation levels (I)		
Daily (I_1)	7.14	37.75
Alternate days (I_2)	7.73	37.91
Once in 3 days (I_3)	6.86	39.00
CD (0.05)	**NS**	**NS**
Mulching (M)		
No Mulch- M_1	7.11	38.75
Plastic Mulch- M_2	7.51	38.75
Leaf Mulch- M_3	7.11	37.16
CD (0.05)	**NS**	**1.16**
Spacing (S)		
S_1- 75 X 75 cm	6.14	38.41
S_2 90 X 90 cm	8.35	38.02
CD (0.05)	**1.33**	**NS**
I x M		
I_1 X M_1	6.21	38.62
I_1 X M_2	8.72	37.62
I_1 X M_3	6.49	37.00
I_2 X M_1	8.90	37.87
I_2 X M_2	6.77	39.12
I_2 X M_3	7.54	36.75
I_3 X M_1	6.21	39.75
I_3 X M_2	7.05	39.50
I_3 X M_3	7.32	37.75
CD (0.05)	**NS**	**NS**
I x S		
I_1 X S_1	6.39	37.75
I_1 X S_2	7.89	37.75
I_2 X S_1	5.95	37.66
I_2 X S_2	9.52	38.16
I_3 X S_1	6.09	39.83
I_3 X S_2	7.63	38.16
CD (0.05)	**NS**	**NS**
M x S		
M_1 X S_1	5.51	39.16
M1X S2	8.70	38.33
M_2 X S_1	6.69	39.16
M_2 X S_2	8.33	38.33
M_3 X S_1	6.23	36.91
M_3 X S_2	8.01	37.41
CD (0.05)	**NS**	**NS**
I x Mx S		
I_1 X M_1 X S_1	5.35	39.50
I_1 X M_1 X S_2	7.07	37.75
I_1 X M_2 X S_1	7.45	37.25
I_1 X M_2 X S_2	9.99	38.00

I_1 X M_3 X S_1	6.38	36.50
I_1 X M_3 X S_2	6.60	37.50
I_2 X M_1 X S_1	5.89	37.25
I_2 X M_1 X S_2	11.92	38.50
I_2 X M_2 X S_1	5.95	39.50
I_2 X M_2 X S_2	7.59	38.75
I_2 X M_3 X S_1	6.01	36.25
I_3 X M_3 X S_2	9.06	37.25
I_3 X M_1 X S_1	5.30	40.75
I_3 X M_1 X S_2	7.13	38.75
I_3 X M_2 X S_1	6.69	40.75
I_3 X M_2 X S_2	7.42	38.25
I_3 X M_3 X S_1	6.29	38.00
I_3 X M_3 X S_2	8.35	37.50
CD (0.05)	**NS**	**NS**

Observation on yield of Amorphophallus during 2016 - 2017 showed that corm weight was greatly influenced by irrigation levels, mulching and spacing (Table 5). Corm yield was lowest in the plot where irrigation frequency was once in three days (21.02 t/ha). Moisture stress has resulted in yield reduction. Mulching greatly influences yield of Amorphophallus; weight of corms in leaf mulched plot was higher than plastic mulched and no mulched plot. Yield in leaf mulched plot was 38.11 t/ha while in plastic mulched and no mulched plots were 23.50 and 19.50 t/ha (Figure 2).

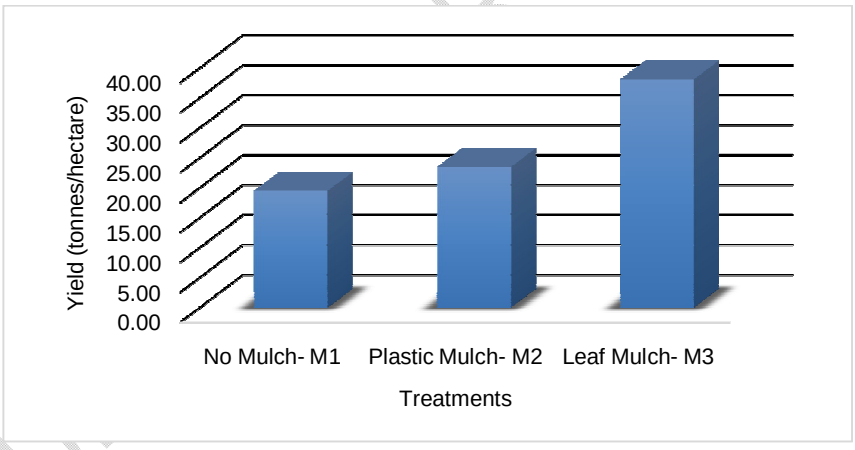

Fig. 2: Effect of different mulches on yield of Amorphophallus

Yield of the crop was not significantly influenced by spacing. Interaction effect of irrigation, mulching and spacing showed that yield of the crop was highest in daily irrigated plot with 90 cm x 90 cm spacing and leaf mulching even though it was not significant. This inference is supported from the results of Ravi et al. (2014) that *Amorphophallus* can yield more and produce larger corms when the moisture is adequate. The results are also in confirmative with the results obtained by Mathew et al. (1988) the corm yield was significantly higher in mulched plots compared to the no mulched plots and highest yield was observed in the plot mulched using dried leaves. Effect of treatments on water productivity

and BC ratio showed that leaf mulching of the crop has significant effect on these parameters. In leaf mulched plot, water productivity in 2016-17 was 2.03 while it was only 1.854 and 0.886 in 2017-18 and 2018-19. Similarly, BC ratio was highest for leaf mulched plot followed by no mulch and plastic mulch plot. Ghimire et al. (2021) conducted an economic analysis among different mulching materials and found that highest cost of cultivation was incurred in white plastic mulch trial and lowest for no mulched trial. This could be the reason for the higher B:C ratio in the leaf mulched trial compared to the plastic mulched trial. Generally, yield of the crop was highest in daily irrigated plot. But in 2017-18, plots which were irrigated daily was infected by leaf blight disease, that reduced the crop yield. Considering B:C ratio and water productivity, irrigation in an interval of three days along with leaf mulching gives better yield and water productivity.

Table 5. Effect of treatments on yield, water productivity (WP) and BC ratio of *Amorphophallus*.

Treatment	**2016- 2017**			**2017- 2018**			**2018- 2019**			**Pooled**	
	Yield (t ha^{-1})	**WP (kg m^{-3})**	**BC Ratio**	**Yield (t ha^{-1})**	**WP (kg m^{-3})**	**BC Ratio**	**Yield (t ha^{-1})**	**WP (kg m^{-3})**	**BC Ratio**	**Yield (t ha^{-1})**	**BC Ratio**
Irrigation levels (I)											
Daily (I_1)	24.28	1.21	0.90	30.41	1.03	1.18	22.70	0.72	0.89	25.80	0.99
Alternate days (I_2)	25.22	1.43	0.96	40.97	1.51	1.57	20.62	0.70	0.79	28.94	1.10
Once in 3 days (I_3)	21.02	1.26	0.79	40.90	1.51	1.48	18.40	0.64	0.72	26.37	0.99
CD (0.05)	10.25	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mulching (M)											
No Mulch- M_1	14.42	0.80	0.64	26.87	0.93	1.18	18.40	0.61	0.84	19.50	0.88
Plastic Mulch- M_2	19.18	1.06	0.56	34.37	1.26	1.01	16.94	0.57	0.50	23.50	0.69
Leaf Mulch- M_3	36.92	2.03	1.43	51.04	1.85	2.04	26.38	0.89	1.06	38.11	1.50
CD (0.05)	10.70	0.60	0.43	12.70	0.50	0.58	NS	NS	0.45	6.22	0.25
Spacing (S)											
S_1- 75 X 75 cm	26.21	1.44	0.92	41.38	1.22	1.14	19.12	0.64	0.66	19.50	0.90
S_2 90 X 90 cm	20.80	1.15	0.84	33.47	1.48	1.68	22.03	0.74	0.94	23.50	1.15
CD (0.05)	8.36	NS	NS	NS	NS	0.47	NS	NS	NS	NS	0.21
I X M											

I_1 X M_1	12.46	0.62	0.53	22.29	0.76	1.02	22.29	0.71	1.02	19.01	0.86
I_1 X M_2	18.21	0.90	0.53	21.66	0.73	0.65	18.75	0.60	0.54	19.54	0.57
I_1 X M_3	42.17	2.09	1.63	47.29	1.60	1.87	27.08	0.86	1.10	38.84	1.53
I_2 X M_1	18.08	1.03	0.81	33.95	1.25	1.56	18.33	0.62	0.83	23.45	1.06
I_2 X M_2	21.17	1.20	0.63	38.54	1.42	1.12	18.54	0.63	0.55	26.08	0.76
I_2 X M_3	36.42	2.07	1.43	50.41	1.86	2.03	25.00	0.85	0.98	37.28	1.48
I_3 X M_1	12.73	0.76	0.60	24.37	0.79	0.96	14.58	0.51	0.67	16.03	0.74
I_3 X M_2	18.16	1.09	0.54	42.91	1.63	1.28	13.54	0.47	0.40	24.87	0.73
I_3 X M_3	32.17	1.93	1.23	55.41	2.10	2.20	27.08	0.95	1.09	38.22	1.51
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
I X S											
I_1 X S_1	29.45	1.46	1.03	34.02	0.91	0.94	19.58	0.62	0.67	25.27	0.88
I_1 X S_2	19.11	0.95	0.76	26.80	1.15	1.42	25.83	0.82	1.11	26.32	1.09
I_2 X S_1	25.17	1.43	0.89	44.30	1.39	1.27	21.25	0.72	0.74	28.02	0.97
I_2 X S_2	25.28	1.44	1.02	37.63	1.63	1.88	20.00	0.68	0.83	29.86	1.24
I_3 X S_1	24.02	1.44	0.83	45.83	1.36	1.22	16.52	0.58	0.57	25.50	0.87
I_3 X S_2	18.02	1.08	0.75	35.97	1.65	1.75	20.27	0.71	0.87	27.25	1.12
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
M X S											
M_1 X S_1	17.11	0.93	0.70	31.66	0.80	0.90	17.08	0.57	0.70	18.75	0.76
M1X S2	11.74	0.67	0.59	22.08	1.06	1.46	19.72	0.66	0.99	20.24	1.01
M_2 X S_1	18.41	1.02	0.51	34.72	1.25	0.94	18.88	0.63	0.52	23.77	0.65
M_2 X S_2	19.95	1.11	0.63	34.02	1.27	1.09	15.00	0.50	0.47	23.22	0.73
M_3 X S_1	43.11	2.38	1.55	57.78	1.61	1.59	21.38	0.72	0.77	36.27	1.30
M_3 X S_2	30.73	1.68	1.32	44.30	2.10	2.48	31.38	1.05	1.35	39.96	1.71
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
I X M X S											
I_1 X M_1 X S_1	20.42	1.01	0.83	25.00	0.66	0.80	19.58	0.62	0.80	19.86	0.81
I_1 X M_1 X S_2	4.50	0.22	0.22	19.58	0.85	1.24	25.00	0.80	1.24	18.16	0.90
I_1 X M_2 X S_1	19.08	0.95	0.52	25.83	0.59	0.48	22.91	0.73	0.63	19.83	0.54
I_1 X M_2 X S_2	17.33	0.86	0.54	17.50	0.88	0.81	14.58	0.46	0.46	19.25	0.60
I_1 X M_3 X	48.84	2.42	1.75	51.25	1.47	1.55	16.25	0.52	0.58	36.14	1.29

S_1											
I_1 X M_3 X S_2	35.50	1.76	1.52	43.33	1.74	2.19	37.91	1.21	1.61	41.55	1.78
I_2 X M_1 X S_1	21.33	1.21	0.87	38.75	1.07	1.19	18.33	0.62	0.75	22.94	0.93
I_2 X M_1 X S_2	14.83	0.84	0.74	29.16	1.43	1.94	18.33	0.62	0.92	23.97	1.20
I_2 X M_2 X S_1	16.83	0.96	0.46	30.41	1.72	1.28	18.33	0.624	0.50	27.27	0.75
I_2 X M_2 X S_2	25.50	1.45	0.80	46.66	1.12	0.96	18.75	0.64	0.59	24.89	0.78
I_2 X M_3 X S_1	37.34	2.12	1.34	63.75	1.37	1.33	27.08	0.92	0.97	33.83	1.22
I_3 X M_3 X S_2	35.50	2.02	1.52	37.08	2.35	2.74	22.91	0.78	0.98	40.72	1.75
I_3 X M_1 X S_1	8.55	0.57	0.39	31.25	0.66	0.71	13.33	0.46	0.55	13.47	0.55
I_3 X M_1 X S_2	7.08	0.95	0.80	17.50	0.91	1.21	15.83	0.55	0.80	18.60	0.93
I_3 X M_2 X S_1	12.96	1.16	0.53	47.91	1.44	1.05	15.41	0.54	0.43	24.21	0.67
I_3 X M_2 X S_2	8.55	1.02	0.54	37.91	1.82	1.51	11.66	0.41	0.36	25.53	0.81
I_3 X M_3 X S_1	27.83	2.58	1.55	58.33	1.99	1.89	20.83	0.73	0.75	38.83	1.40
I_3 X M_3 X S_2	8.59	1.27	0.91	52.50	2.21	2.51	33.33	1.16	1.44	37.61	1.62
CD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

4. CONCLUSION

Study on different levels of irrigation, mulching and plant population on water conservation and productivity of irrigated Amorphophallus showed that mulching had significant effect on the yield and B:C ratio of the crop and it was highest with leaf mulched plot. Plastic mulching had significant effect on weed control but the yield was higher in leaf mulched plot compared to that in plastic mulched plot. The B:C ratio was lowest in plastic mulched plot due to the high cost of mulching sheet. Crop yield was not significantly influenced by plant population. The B:C ratio was significantly highest under spacing of 90 cm x 90 cm. From the experimental results, it can be concluded that Amorphophallus planted at a spacing of 90 cm x 90 cm, irrigated at a frequency of once in three days along with leaf mulching can increase the yield and water productivity along with effective control of weed population.

Comment [a10]: Replace by this conclusion to 'From the experimental results, it was concluded that Amorphophallus planted at a spacing of 90 cm x 90 cm, irrigated at a frequency of once every three days, along with leaf mulching, increased the yield and water productivity, along with effective control of weed population'.

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Comment [a11]: All references should follow the journal format. Check author guideline