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Impact of different level of fertigation with and without mulch on growth, yield and yield attributing characteristics of bitter gourd (*Momordica charantia* L.) cv. Shreya

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Abstract
The present investigation was carried out at the Krishi Vigyan Kendra, Gariyaband (Chhattisgarh) to know the impact of different level of fertigation with and without mulch on growth, yield and yield attributing characteristics of bitter gourd during *Rabi* season 2018-19. The experiment was laid out in Factorial RBD with eight treatment combinations and three replications. The experimental plots were treated with four fertigation levels *i.e*. 100% RDF through conventional, 100% RDF,80 % RDF and 60 % RDF through fertigation and two levels of mulching materials consisting of without mulch and silver plastic mulch. The results under the study indicated that 100% RDF through fertigation gave maximum plant height, number of branches, maximum fruit yield which was found statistically *at par* with 80% RDF through fertigation. Silver plastic mulch was significantly superior over without mulch.

Keywords: bitter gourd, yield, drip, fertigation, mulch

Introduction
Bitter gourd is one of the leading vegetable crops of India and farmers prefer this crop due to its higher yield and maximum returns (Naveen Kumar, *et al.*, 2012) [4]. Anti-diabetic properties of bitter gourd make it a favorite among consumers. The fruits are also rich in vit C, phosphorus and iron. The crop enjoys a comparatively steady market price and market demand that makes it the most preferred vegetable crop among farmers. Rising labour and input costs demands the adoption of technologies that can improve the productivity and the profitability of bitter gourd cultivation in Chhattisgarh. The sources of irrigation water are limited and the demand for agricultural produces is increasing. Therefore, it is necessary to adopt efficient use of water through micro irrigation systems like drip which saves 27 to 42 per cent of water. The micro irrigation area has been increasing steadily. Micro irrigation helps to conserve irrigation water and increase water use efficiency by reducing soil evaporation and drainage losses. It also helps to maintain soil moisture conditions that are favorable to crop growth. Thus micro irrigation can help to sustain the productivity of the land. Among the different crops vegetables have been found to be highly responsive to micro irrigation. Bitter gourd (*Momordica chanrantia* L.) crop is grown on a sizeable area owing to its food and medicinal importance. It is a member of the Cucurbitaceous family. It is widely grown in China and India and throughout Southeast Asia. The present investigation was, therefore, undertaken to find out the optimum drip irrigation levels for bitter gourd in order to economize the use of water and to enhance the productivity.

Materials and Methods
A field experiment was carried out during the year 2018-19 in *Rabi* season at Krishi Vigyan Kendra, Gariyaband (C.G.). The experiment was laid out in a factorial RBD design with eight treatment combinations and three replications. The experimental plots were treated with four fertigation levels *i.e*. 100% RDF through conventional, 100% RDF, 80 % RDF and 60 % RDF through fertigation and two levels of mulching materials consisting of without mulch and silver plastic mulch. The drip system was laid out parallel to the crop rows and each lateral with emitters distance 30 cm with the 2 liter water per hour discharge rate. Irrigation and fertigation scheduled on alternate days in case of drip irrigation.

Water soluble fertilizers like 12:61:00, 20:10:10 and 19:19:19 was given according to treatment combinations at 3-4 days intervals. The observations regarding growth parameters i.e. plant height (cm) at Harvest, number of branches at harvest, days taken for initiation of male flowers, days taken for initiation of female flowers, number of fruits/plant, average fruit weight (g), fruit length (cm), fruit girth (cm), yield (kg/plant), yield (t/ha) was recorded from randomly selected five plants in each plot. The data obtained on various characters were subjected to Factorial RBD analysis and interpretation of the data was carried out in accordance to Panse and Sukhatme (1985) [5].

Results and Discussion

Effect of fertigation on growth, yield and yield components: The data on the effect of different level of fertigation with and without mulch on growth and yield of bittergourd are presented in the Table 1. It is evident from the data (Table 1 & 2) that all the characters i.e. plant height (cm), number of branches, days taken for initiation of male flowers, days taken for initiation of female flowers, no. of fruits per plant, fruit length (cm), average weight of one fruit (g), fruit girth (cm), fruit yield (kg/plant) and fruit yield (t/ha) were significantly influenced by different levels of fertigation. Application of 100% RDF through fertigation showed maximum plant height (231.15 cm), number of branches (9.32), no. of fruits per plant (30.16), fruit length (17.50 cm), average weight of fruit (72.91 g), fruit girth (8.16 cm), fruit yield (4.20 kg/plant) and fruit yield (24.06 t/ha) which was found statistically *at par* with 80% RDF through fertigation. It might be due to application of higher dose of fertilizers attributed to better nutritional environment in the root zone as well as in plantsystem. Nitrogen, phosphorus and potassium are most indispensable of all mineral nutrients for growth and development of the plant as these are the basis of fundamental constituents of all living matter (Throughton *et al*., 1974) [8]. This result is supported by Guertal (2000) [3], Rekha and Mahavishnan (2008) [6], who reported that drip irrigation with 120% and 100% of recommended dose of N fertigation, respectively, recorded maximum productivity and yield in different crops. Both nitrogen and potassium may be important nutrient for leaf growth and development. Total nitrogen and potassium uptake was appreciable higher with increasing nitrogen and potassium rate with more frequent than with less frequent fertigation.

Effect of mulch on yield and yield components : The growth, yield and yield contributing characters like plant height, fruit length, fruit girth and unit fruit weight were influenced significantly by different levels of mulch (Table1 & 2). Plastic mulch showed maximum plant height (214.16 cm) and number of branches (8.46). Similarly there was significant response of mulches on various yield components. Various yield attributing characters i.e. number of fruits per plant (28.62), fruit length (16.17 cm), fruit girth, average weight of fruit (69.11 g), fruit yield per plant (3.95 kg), fruit yield (21.32 t/ha) were also found maximum with polythene mulch. The increased yield under plastic mulch might have resulted from better water utilization, higher uptake of nutrient and excellent soil-water-plant relationship. The yield components and yield were significantly greater at all levels of fertigation in mulched treatments as compared to unmulched treatments. This result is supported by the findings of Ashrafuzzaman *et al*. (2011) [1] and Biswas *et al*. (2015) [2]. Mulches had a significant positive effect on plant height and the effect was more pronounced in lower water regime treatment than higher water regime treatment. Fruit length and fruit weight were found the maximum in drip irrigation with mulches. Mulches reduced the rate of water loss through evaporation from soil surface. So, the soil-water-plant relationship was better in low irrigation regime than high irrigation regime that might help produce higher yield and thereby higher WUE. By reducing the loss of soil moisture, mulches lessen the frequency of necessary watering, and the vegetable suffers less in dry spell periods. Organic mulches also increase the water absorption rate of soils. The reduced soil temperatures under organic mulches encourage root growth in the upper soil layer where there is more oxygen and fertilizer. The mulch reduces the splattering of soil on vegetable leaves and fruit during rains or sprinkling. The microclimate condition improved by the mulches might have provided a suitable condition for producing higher number of leaves in the plants. The increase in yield of mulched plots was probably associated with the conservation of moisture, improved microclimate both beneath and above the soil surface, light reflection and great weed control, especially in silver plastic mulch (Rajablariani *et al*., 2012) [7].

Table 1: Effect of different levels of fertigation and mulching on growth and grow attributing characters in bittergourd (*Momordica charantia* L.)

Treatments	plant height (cm) at Harvest	number of branches at harvest	days taken for initiation of male flowers	days taken for initiation of female flowers
F1- 60% RDF	172.87	7.32	41.02	43.63
F2- 80% RDF	180.00	7.81	40.23	46.03
F3- 100% RDF	231.15	9.32	38.07	41.71
F4- Control	182.60	7.68	39.43	44.11
CD at 5%	79.97	2.34	7.11	7.70
M1-Plastic mulch	214.16	8.46	39.79	44.29
M2-Without mulch	167.88	7.61	38.48	42.45
CD at 5%	57.25	1.66	5.03	5.45

Table 2: Effect of different levels of fertigation and mulching on yield and yield attributing characters in bittergourd *(Momordica charantia* L.)

Treatments	number of fruits/ plant	average fruit weight (g)	fruit length (cm)	fruit girth (cm)	yield (kg/ plant)	Yield (t/ha)
F1- 60% RDF	26.27	67.73	12.10	6.83	3.54	18.13
F2- 80% RDF	28.69	70.65	15.00	7.17	3.65	22.20
F3- 100% RDF	30.16	72.91	17.50	8.16	4.20	24.06
F4- Control	26.86	54.27	13.83	7.18	3.84	19.90
CD at 5%	6.93	10.27	4.20	3.50	0.52	3.59

M1-Plastic mulch	28.62	69.11	16.17	7.54	3.95	21.32
M2-Without mulch	27.37	64.53	13.00	7.13	3.74	20.82
CD at 5%	4.90	7.26	2.97	2.48	0.40	5.07

Economics:

Treatments	Material cost	Drip and Mulching cost	Labour cost	Total cost	Yield t/ha	Gross return	Net return	Benefit Cost Ratio
F_1M_1	6500	150000	20000	176500	17.00	425000	248500	1.41
F_1M_2	5000	120000	40000	165000	19.26	481500	316500	1.92
F_2M_1	7500	150000	20000	177500	22.73	568250	390750	2.20
F_2M_2	7000	120000	40000	167000	21.66	541500	374500	2.24
F_3M_1	8500	150000	20000	178500	25.30	632500	454000	2.54
F_3M_2	8000	120000	40000	168000	22.83	570750	402750	2.40
F_4M_1	9500	150000	20000	179500	20.26	506500	327000	1.82
F_4M_2	9000	120000	40000	169000	19.53	488250	319250	1.89

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