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Studies on fertigation in bitter gourd (*Momordica charantia* L.)

A. A. HARI AND L. GIRIJA DEVI

Department of Agronomy, College of Agriculture
Vellayani-695522, Kerala

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ABSTRACT

A field experiment was conducted during 2015 to standardize the fertigation schedule for precision farming in bitter gourd variety 'Preethi', to assess the impact of precision farming practices on yield of the crop and to work out the economics. The experiment was laid out in split plot design with four replications. The main plot treatments included four fertigation levels (l) viz., l_1- 75 % recommended dose (RD) of N and K, l_2- 100 % RD of N and K, l_3- 150 % RD of N and K and l_4- 200 % RD of N and K. Fertigation intervals (i) (i_1- at 4 days interval and i_2- at 8 days interval) formed the sub plot treatments. Two controls were included in the study, viz., control 1- Kerala Agricultural University (KAU) ad hoc recommendation for precision farming and control 2- KAU Package of Practices (POP) recommendation. P was applied uniformly (25 kg ha^{-1}) to all treatments except control 1. The results revealed that the application of 100 % RD (l_2) recorded the highest fruit yield, fruit number, number of harvests and total dry matter yield. Economic analysis revealed the superiority of fertigation treatments over both the control and within fertigation, the level l_2 recorded the highest B:C ratio and the net income was the highest in l_2i_1.

Keywords: Bitter gourd, economics, fertigation, precision farming, yield

Bitter gourd (*Momordica charantia* L.) occupies a prominent position among the vegetables cultivated during the summer season in Kerala and the importance of this vegetable has long been accepted. Bitter gourd is mainly cultivated for its green edible fruits containing high nutritional and medicinal value. The fruits are rich source of vitamin C, phosphorus and iron (Wills *et al.*, 1984). The fruits, flowers and young shoots can also be used as flavorings (Marr *et al.,* 2004). Technologies useful in increasing the production and net income per unit area by the cultivation of this crop need emphasis. Water and fertilizer are the two costly inputs in vegetable production. Water is, however the most limiting among them during summer season. It influences the availability and uptake of plant nutrients as well as growth and yield. The full potential of any cultivar of a crop can be exploited only with judicious water and fertilizer management practices. Drip irrigation system when compared with other methods of irrigation have lower water consumption, a reduction in the incidence of diseases, higher yields, and better quality of the produce (Hochmuth, 1994) and it also enhances the movement of nutrients like P and K in soil (Hebbar *et al*., 2004).

Fertigation is used as one of the most effective and convenient method of supplying nutrient and water according to the specific requirements of the crop to maintain optimum soil fertility and better quality produce (Shirgure *et al.*, 2000). Drip fertigation also plays a major role in summer season for irrigation and nutrient application as there is a shortage of irrigation water and high competition for available water resources. The full potential of any cultivar of a crop can be exploited only with judicious water and fertilizer management practices. Since the cost of inputs mainly nutrients is increasing and water is becoming limited, new technologies like drip fertigation, site specific nutrient application and soil test based nutrient application *etc.* have to be developed for the efficient use of these resources for a précised farming situation. Hence to assess the profitability of precision farming for increasing the yield and improving the quality of bitter gourd the present experiment was conducted to standardize the fertigation schedule for precision farming in bitter gourd, to assess the impact of precision farming practices on yield and to work out the economics.

MATERIALS AND METHODS

A field experiment with bitter gourd (*Momordica charantia* L.) variety 'Preethi' was conducted during the summer season (March-June) of 2015 in College of Agriculture, Vellayani, Thiruvananthapuram. The experiment was at farmer's field at Pirappancode, Thiruvananthapuram district, Kerala, India, located at 8°392 03 N latitude and 76°552 03 E longitude at an altitude of 18 m above mean sea level. The experiment was conducted in split plot design with 4 replications. The main plot treatments were four fertigation levels *viz.*, l_1- 75 per cent recommended dose (RD) of N and K, l_2- 100 per cent RD of N and K, l_3- 150 per cent RD of N and K and

Email: *anjaliahari@gmail.com*

l_4- 200 per cent RD of N and K and the sub plot treatments were fertigation intervals (i) (i_1- at 4 days interval and i_2- at 8 days interval) formed the sub plot treatments. Two controls were also included in the study, *viz.*, control 1- Kerala Agricultural University (KAU) *ad hoc* recommendation for precision farming and control 2- KAU Package of Practices (POP) recommendation (70:25:25 kg NPK ha^{-1}). Urea, Rajphos and Muriate of potash were the inorganic sources. In control 1, water soluble fertilizers, *viz*., Urea, 19:19:19, 13:0:45 and 12:61:0 were used to supply the major nutrients required for the crop through fertigation. . Soil was sandy clay loam and acidic in reaction with medium in available nitrogen, high in available phosphorus and low in available potassium and hence suitable modifications were made and the modified recommendation used was 70:20:32 kg N, P_2O_5 and K_2O ha^{-1}. Organic manure @ 25 t ha^{-1} and lime @ 350 kg ha^{-1} were applied uniformly and thoroughly incorporated. A basal dose of P_2O_5 @ 20 kg ha^{-1} was applied uniformly to all treatments except control 1 were 37 kg ha^{-1} was given as basal dose. In control 2, half nitrogen and entire dose of phosphorus and potassium were applied as basal dose. The remaining half nitrogen was applied in 3 splits at fortnightly intervals. Overnight soaking of seeds in water was done and three seeds per pit was sown uniformly. The seedlings were thinned to two per pit and gap filling was done. Three weedings and soil rakings were given at 15, 35 and 50 days after sowing (DAS) for control 2. Trellis was established with bamboo, casuarina poles and plastic nets and plants were trailed on this. All the treatments except control 2 were irrigated by drip irrigation. Daily irrigation was practised and the quantity of water applied was calculated based on growth stage of crop. Online drippers (1 dripper pit^{-1}) with a discharge rate of 4 L hr^{-1} were used. The fertilizers were applied along with irrigation water at specified intervals for all the treatments and control 1, except control 2, where hose watering was done daily.

The data relating to yield and yield attributes and B:C ratio were statistically analysed by applying the technique of analysis of variance (ANOVA) for split plot design and the significance was tested by F test (Snedecor and Cohran, 1975). In cases where F values were found significant, critical differences (CD) were calculated.

RESULTS AND DISCUSSION

Yield and yield attributes

The fruit yield in bitter gourd was found influenced by fertigation levels and fertigation with the level l_2 (100 % RD of N and K), recorded the highest fruit yield (4.26 kg $plant^{-1}$ and 21.30 t ha^{-1}) (Table 1). As the yield parameters such as number of fruits, number of harvests and harvesting time were found influenced by fertigation levels, and the level l_2 was found superior in all these aspects leading to an increased yield in l_2 (Table 1). Similar results of 100 % RD of fertlilizers were obsvered by Singandhupe *et al.* (2007) in pointed gourd, Meenakshi *et al.* (2008) in bitter gourd and Ughade and Mahadkar (2015) in brinjal. Though harvesting was observed early in l_3, this was found on a par with l_2. Delayed harvesting was observed in l_1 and l_4 where the lowest and the highest level of fertigation. The incremental fertilizer doses might have increased the production of male and female flowers but not to the same extend and the male and female flower ratio might have remained unaffected in l_3 resulting in early harvest, while in l_1 where the lowest level of nutrients were given, the male and female flower ratio might have affected and so late harvest. Similar results have been reported by Raychaudhuri *et al.* (1982) in long melon, Haris (1989) in snake gourd and Ravikrishnan (1989) in bitter gourd.

The more frequent harvests in l_2 might be due to the highest number of fruits produced in l_2. The dry matter yield at 55 DAS was the highest in l_3 and at final harvest and it was in l_2. The lower photosynthesis efficiency due to low LAI results in low dry matter yield. Similar results were reported by Thomas (1984) and Lakshmi (1997) in cucurbits. As fruit yield was the highest in l_2, the dry matter yield at final harvest stage was also the highest in l_2, as dry matter yield at harvest stage is the sum total of both the dry weight of the vegetative portion and dry weight of all the fruits harvested from it. On perusal and comparison of results on both the controls and fertigation treatments it can be seen that the fruit length was the highest in control 2 where the entire dose of N and K were applied as basal. Application of potassium as basal dose may be attributed to the cell expansion, division and translocation of large quantity of photosynthates to fruits might have resulted in higher mean length of fruits (Lakshmi, 1997). The dry matter yield at 55 DAS was found to be the lowest in control 2 compared to control 1 and fertigation treatment.

Table 1: Effect of treatments on yield, yield attributes and B:C ratio of bitter gourd.

Treatments	Mean fruit length unit	Mean fruit girth (cm)	Mean fruit weight unit	Yield kg plant^{-1}	Yield t ha^{-1}	No. of fruits plant^{-1}	First harvest (days)	Number of harvests (g plant^{-1})	Total dry matter yield	B:C ratio
Fertigation levels (l)										
l_1	24.92	21.67	229.30	3.54	17.71	28.15	64.80	5.03	557.28	4.12
l_2	24.71	21.94	226.71	4.26	21.30	31.76	62.77	5.74	636.92	4.94
l_3	24.73	21.84	225.37	3.69	18.43	26.78	62.25	4.82	561.21	4.25
l_4	24.65	22.07	231.41	3.37	16.84	25.65	64.42	4.87	541.19	3.86
SEm (±)	**0.236**	**0.288**	**1.880**	**0.13**	**0.644**	**1.005**	**0.491**	**0.127**	**15.498**	**0.147**
LSD (0.05)	**NS**	**NS**	**NS**	**0.416**	**2.061**	**3.215**	**1.569**	**0.405**	**49.577**	**0.471**
Fertigation intervals (i)										
i_1	24.82	21.86	222.30	18.47	62.77	28.21	62.77	5.10	560.74	4.26
i_2	24.68	21.89	234.10	18.67	62.25	27.95	62.25	5.13	587.55	4.32
SEm (±)	**0.17**	**0.228**	**3.889**	**0.645**	**0.634**	**0.860**	**0.634**	**0.174**	**12.264**	**0.148**
LSD (0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Treatment mean	24.75	21.88	228.20	18.57	63.56	28.08	63.56	5.11	574.15	4.29
Control 1	24.84	21.9	231.19	18.68	65.00	28.38	65.00	4.25	588.67	2.74
Control 2	26.03	22.36	227.61	17.05	64.00	25.59	64.00	4.38	563.93	3.21
Control 1and Control 2	S	NS	NS	NS	NS	NS	NS	NS	NS	NS
Control 1 vs. Treatment	NS	NS	NS	NS	NS	NS	NS	S	NS	S
Control 2 vs. Treatment	S	NS	NS	NS	NS	NS	NS	NS	NS	S

Note: l_1- 75 % RD of N and K, l_2- 100 % RD of N and K, l_3- 150 % RD of N and K, l_4- 200 % RD of N and K, i_1- fertigation at 4 days interval, i_2- fertigtaion at 8 days interval, control 1- KAU ad hoc recommendation and control 2- KAU POP recommendation.

Economics of fertigation

The B:C ratio was the highest in l_2 (4.94), this might be due to the highest fruit yield in l_2 (Table 1), and the highest gross and net income in l_2i_1, (Table 2). On comparison of results of fertigation treatments and the two controls, it was found that the B:C ratio was the highest in fertigation treatments than both the controls (4.29, 2.74 and 3.21 respectively) and among the two controls, control 1 recorded the lowest B:C ratio because of the high treatment cost involved due to the high cost of inputs in control 1. The net income was the highest in l_2i_1 (6,90,488 ha^{-1}). This could be attributed to the highest fruit yield recorded in l_2. The net income was the lowest in control 2 (4,69,412 ha^{-1}), where conventional method of crop production was practiced (Table 2). Though control 2 gave a comparable fruit yield as that of fertigation treatments, gross income in control 2 was less than in l_2i_1 (Table 2). Moreover the production cost was also high in control 2 because of the manual labour involved in after cultivation operations like weeding and irrigation compared to fertigation treatments. These might be the reasons for the low net income in control 2.

From the study it can be concluded that the current nutrient recommendation of KAU (70:25:25 kg N, P_2O_5 and K_2O ha^{-1}) is sufficient for bitter gourd, but giving it through fertigation the yield can further be increased. Based on the results, a fertigation schedule of 152 kg ha^{-1} urea and 53 kg ha^{-1} MOP at 4 days interval along with a basal dose of 100 kg ha^{-1} rajphos (equivalent to 70:25:25 kg N, P_2O_5 and K_2O ha^{-1}) can be given as a recommendation for precision farming in bitter gourd in the sandy clay loam soils of Kerala, where the soil is medium in N, low in P and high in K status, for high yield, quality produce and the highest net income and B:C ratio.

Table 2. Economics of interaction of fertigation levels and intervals.

Treatments	Total cost excluding treatment cost (Rs. ha^{-1})	Treatment cost	Total cost (Rs. ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	B:C ratio
l_1i_1	106864	65617	172481	694500	522019	4.03
l_1i_2	106864	65029	171893	722000	550107	4.20
l_2i_1	106864	66148	173012	863500	690488	4.99
l_2i_2	106864	65560	172424	840500	668076	4.88
l_3i_1	106864	67210	174074	739000	564926	4.25
l_3i_2	106864	66622	173486	735000	561514	4.24
l_4i_1	106864	68272	175136	657500	482364	3.76
l_4i_2	106864	67684	174548	689000	514452	3.95
Control 1	106864	166087	272951	747000	474049	2.74
Control 2	106864	105724	212588	682000	469412	3.21

REFERENCES

Haris, A. A. 1989. Nutrient management in snake gourd (*Trichosanthes anguina* L.) under partial shade. *M. Sc.(Ag.) Thesis*, Kerala Agricultural University, Vellanikara, Thrissur. 78p.

Hebbar, S. S., Ramachandrappa, B. K., Nanjappa, H. V., and Prabhakar, M. 2004. Studies on NPK drip fertigation in field grown tomato (*Lycopersicon esculentum* Mill.). *Eur. J. Agron.* **21**: 117-127.

Hochmuth G.J. 1994. Current status of drip irrigation for vegetables in Southeastern and mid-Atlantic United States. *Hort Technol.* **4**: 390-93.

Lakshmi, S. 1997. Response of cucumber (*Cucumis melo* L.) to drip irrigation under varying levels of nitrogen and potash. *Ph. D. (Ag) thesis*, Kerala University, Thrissur. 216p.

Marr, K. L., Mei, X. Y., and Bhattarai, N. K. 2004. Allozyme, morphological and nutritional analysis bearing on the domestication of *Momordica charantia* L. (Cucurbitaceae). *Eco. Bot.* **58**: 435-55.

Meenakshi, N., Vadivel, E., Veeraragavathatham, D., and Kavitha, M. 2008. Nutrient uptake and dry matter production as influenced by fertigation in bitter gourd (*Momordica charantia* L.). *Crop Res*. **36**: 208-11.

Ravikrishnan, M. K. 1989. Nutrient management in bitter gourd (*Momordica charantia* L.) under partial shade. *M. Sc. (Ag) Thesis*, Kerala Agricultural University, Thrissur, 122p.

Raychaudhuri, A., Mitra, S. K., and Bose, T. K. 1982. A note on the nutrition of long melon. *Veg. Sci.* **9**: 8-12.

Snedecor, G. W. and Cohran, W. G. 1975. *Statistical Methods.* Oxford and IBH Publishing Company, New Delhi, 593p.

Shirgure, P. S., Srivastava, A. K., and Singh, S. 2000. Fertigation and drip irrigation in Nagapur mandarin (*Citrus reticulate* Blanco.). *S. Indian Hort.* **49**:95-97.

Singandhupe, R. B., James, B. K., Antony, E., Nanda, P., and Behera, M. S. 2007. Response of drip fertigation and mulching on growth and fruit yield of pointed gourd (*Trichosanthes dioica*). *Indian J. Agric. Sci.* **77**: 8-13.

Thomas, C. G. 1984. Water management practices for bitter gourd (*Momordica charantia* L.) under different fertility levels. *M.Sc. (Ag) Thesis*, Kerala University, Thrissur. 112p.

Ughade, S. R. and Mahadkar, U. V. 2015. Effect of different planting density, irrigation and fertigation levels on growth and yield of Brinjal. *J. Prog. Agric.* **6**: 103-109.

Wills, R. B. H., Scriven, A. W. K., and Greenfield, H. 1984. Nutrient composition of Chinese vegetables. *J. Agric. Food Chem.* 32: 413-416.