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Influence of planting time and fertilizer application on fruit yield and quality of bitter gourd (*Momordica charantia*) (var. Pusa Rasdar) for off-season production under protected condition

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Bitter gourd (*Momordica charantia* L.) is a common vegetable crop belonging to family Cucurbitaceae distributed across with tropical and subtropical regions. It is first among the cucurbits for its nutrition value, being a good source of carbohydrates, proteins, vitamins and minerals, besides providing health benefits by supplying synthetic antioxidants (Behera *et al*. 2007). Recently, bitter gourd production is gaining importance due to its medicinal value, higher yield and income in short period of time. However, year round cultivation of bitter gourd under open field condition is limited due to prevailing low temperatures during winter that causes frost injury. Therefore, in order to provide suitable growing conditions to crop, adjustment of planting time is decisive for better bitter gourd production with enhanced productivity. However, polyhouse production can also be commercially exploited for off-season production of cucurbitaceous crop in winter season with increased yield and quality of produce as compared to open field conditions (Sharma *et al*. 2005). In protected cultivation, nutrient management through fertigation is an important cultural aspect to enhance the productivity of cucurbits. Now it is well established that nitrogen at higher doses promotes the plant to produce more number of male flowers and vice versa in cucurbits (Bose *et al*. 1993). Thus, adjusting date of planting and amount of fertilizer to be applied to decrease sex ratio and enhance the productivity of bitter gourd under protected condition is important for its successful cultivation. However, no information is available for cultivation of bitter gourd under polyhouse condition along with different dates of planting and fertilizer levels. In view of the above, the present investigation was conducted to study the effect of planting time and fertilizer application on the production potential and fruit nutrient content of bitter gourd var. Pusa Rasdar under polyhouse condition.

The experiment was conducted in protected structure (naturally ventilated polyhouse) at the Centre for Protected Cultivation Technology (CPCT), Indian Agricultural Research Institute (IARI), New Delhi during August, 2015 to January, 2016. Experiment was laid out in factorial randomized block design with three replications. The treatments were formulated with three dates of planting, viz. 15 August (P_1), 1 September (P_2) and 15 September (P_3) with four different doses of fertilizers, i.e. 15:7:16 kg (D_1), 20:12:21 kg (D_2), 25:17:26 kg (D_3) and 30:22:31 kg (D_4) per 1000 sq m. The planting of bitter gourd (var. Pusa Rasdar) was done at the spacing of 50×30 cm under 500 sq m area of naturally ventilated polyhouse protected structure. To meet the requirement of recommended doses of plant nutrients, i.e. urea (46:0:0), urea phosphate (17:44:0) and potassium sulphate (0:0:50) were applied as sources of nitrogen (N), phosphorus (P) and potassium (K), respectively. After the flowering, hand pollination was done besides keeping bumble honey bees boxes were used daily at 7-9 AM. Fruits were oven-dried at 70°C and crushed into powder form to determine the fruit nutrient content. For nitrogen estimation, samples were digested according to the method of Chapman and Pratt (1961) and total nitrogen content was determined using Kjeldhal method. Phosphorus content was determined using the method suggested by Jackson (1962). Knudsen *et al.* (1982) method was used to determine potassium content by flame photometer. For trace elements analysis, the method by Edward (1999) was applied using atomic absorption spectrophotometer (AAS).

Present study revealed that planting time had statistically significant influence on yield and yield attributing characters of bitter gourd (Table 1). Among, 15 August planting dates exhibited significantly higher values for fruits/plant (8.57),

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Table 1 Influence of planting time and fertilizers dose on yield attributes and nutrients accumulation in bitter gourd (var. Pusa Rasdar) under protected condition

Treatment	Fruit length (cm)	Fruit diameter (cm)	Number of fruits/ plant	Fruit weight (g)	Yield/ plant (kg)	Yield /1000 sq m (q)	N (mg/100 g)	P (mg/100 g)	K (mg/100 g)	Ca (mg/100 g)	Fe (mg/100 g)	Zn (mg/100 g)
15 August	12.98	5.96	8.57	210.60	1.81	72.55	155.09	36.58	329.17	14.92	0.26	0.58
1 September	13.20	5.56	8.33	203.13	1.71	68.40	152.69	34.83	317.58	14.50	0.26	0.54
15 September	13.70	5.81	6.72	191.74	1.30	51.97	149.39	34.58	308.92	14.67	0.25	0.58
CD (P= 0.05)	0.38	0.12	0.25	1.19	0.05	1.83	2.88	1.20	13.75	NS	NS	NS
SE(m)	0.13	0.04	0.09	0.40	0.02	0.62	0.98	0.41	4.66	0.33	0.00	0.02
Nutrients combination dose (N:P:K @ kg/1000 sq m)												
15:7:16	11.89	5.53	7.02	171.52	1.21	48.43	95.73	31.22	293.56	10.33	0.21	0.52
20:12:21	13.04	5.63	7.67	191.07	1.47	58.83	121.56	34.11	309.89	12.89	0.24	0.57
25:17:26	14.40	6.04	8.42	220.65	1.87	74.62	161.13	36.67	327.22	16.22	0.27	0.59
30:22: 31	13.84	5.91	8.38	224.05	1.88	75.34	231.14	39.33	343.56	19.33	0.31	0.59
CD (P=0.05)	0.44	0.14	0.29	1.37	0.05	2.11	3.33	1.38	15.87	1.12	0.01	NS
SE(m)	0.15	0.05	0.10	0.46	0.02	0.71	1.13	0.47	5.38	0.38	0.00	0.02

fruit diameter (5.96 cm), fruit weight (210.60 g), yield/plant (1.81kg) and yield/1000 sq m (72.55 q). However, it was recorded lowest in 15 September planting, which indicated decreased trends towards later date of plantings. The results obtained are consonance with report of Hossain *et al*. (2001) and Singh *et al*. (2015) in tomato. Fertilizer levels showed significant influence over the yield and yield attributes of bitter gourd (Table 1). The maximum value for fruit length (14.40 cm), fruit diameter (6.04 cm) and fruits/plant (8.42) were recorded by application of 25:17:26 kg NPK/1000 sqm. Whereas, fruit weight (224.05 g), yield/plant (1.88 kg) and yield/1000 sq m (75.34 q) were recorded significantly higher @ 30:22:31 kg/100 sq m of fertilizer application. The lowest value for these parameters was recorded in case of 15:7:16 kg/1000 sq.m. of fertilizer application. The result of nutrient levels was at par with report of Mostafa *et al*. (2012) and Triveni *et al*. (2015). In the present study, variation due to interaction of planting date and different sources of nutrients showed significant increase in yield and yield attributing characters of bitter gourd. Among the combinations-cum-interaction effect with 15th Aug planting and NPK dose @ 30:22:31 kg/1000 sq.m. was recorded highest for number of fruits per plant (9.00), fruit weight (229.99 g), yield/ plant (2.19 g) and yield/1000 sq m (82.80 q), respectively.

Table 2 Interaction effect of planting time and fertilizers level on yield attributes and nutrients accumulation in bitter gourd (var. Pusa Rasdar) under protected condition

Interaction	Fruit length (cm)	Fruit diameter (cm)	Number of fruits/ plant	Fruit weight (g)	Yield/ plant (kg)	Yield /1000 sq m (q)	N (mg/100 g)	P (mg/100 g)	K (mg/100 g)	Ca (mg/100 g)	Fe (mg/100 g)	Zn (mg/100 g)
P1+D1	11.38	6.31	7.73	183.97	1.42	56.89	96.57	32.00	317.33	10.67	0.21	0.52
P1+D2	12.77	5.83	8.47	202.05	1.71	68.42	123.73	35.33	316.67	13.00	0.24	0.57
P1+D3	14.16	5.91	9.07	226.40	2.05	82.11	163.97	38.00	336.33	16.67	0.26	0.59
P1+D4	13.60	5.81	9.00	229.99	2.07	82.80	236.10	41.00	346.33	19.33	0.32	0.64
P2+D1	12.41	4.95	7.47	168.88	1.26	50.42	95.50	31.00	283.33	10.33	0.20	0.51
P2+D2	12.88	5.10	7.87	188.31	1.48	59.25	122.27	33.67	313.33	12.67	0.24	0.56
P2+D3	13.97	6.09	9.07	225.98	2.05	81.96	160.87	36.67	330.00	15.67	0.27	0.59
P2+D4	13.54	6.08	8.93	229.35	2.05	81.95	232.13	38.00	343.67	19.33	0.31	0.49
P3+D1	11.89	5.32	5.87	161.73	0.95	37.98	95.13	30.67	280.00	10.00	0.20	0.53
P3+D2	13.46	5.95	6.67	182.85	1.22	48.81	118.67	33.33	299.67	13.00	0.23	0.57
P3+D3	15.08	6.13	7.13	209.56	1.50	59.80	158.57	35.33	315.33	16.33	0.28	0.59
P3+D4	14.38	5.84	7.20	212.81	1.53	61.28	225.20	39.00	340.67	19.33	0.30	0.64
CD (P=0.05)	NS	0.24	NS	2.37	0.09	3.67	NS	NS	NS	NS	NS	NS
SE(m)	0.26	0.08	0.17	0.80	0.03	1.24	1.95	0.81	9.32	0.66	0.01	0.04

P1:15 August, P2: 1 September, P3: 15 September; D1: 15:7:16 N:P:K , D2: 20:12:21 N:P:K , D3: 25:17:26 N:P:K, D4: 30:22: 31 N:P:K@ kg/1000 sq m; NS: Non significant.

However, lowest value for these parameters was found in 15 Sept. planting with NPK dose @15:7:16 kg/1000 sq m fertilizer application (Table 2).

The present study showed that delayed planting leads to decreased accumulation of nutrients in fruits of bitter gourd. 15 Aug. planting found highest for accumulation of nutrients like nitrogen (155.09 mg/100 g), phosphorus (36.58 mg/100 g), potassium (329.17 mg/100 g), calcium (14.92 mg/100 g), iron (0.26 mg/100 g), and zinc (0.58 mg/100 g) (Table 1). On other hand by increasing fertigation level @ 15:7:16 kg NPK/1000 sqm to 30:22:31 kg NPK/1000 sq m , the nutrient content of fruits was increased (Table 1). Application of 30:22:31 kg of NPK/1000 sq m resulted fruits with highest amount of nitrogen (231.14 mg/100 g), phosphorus (39.33 mg/100 g), potassium (343.56 mg/100 g), calcium (19.33 mg/100 g), iron (0.31 mg/100 g) and zinc (0.59 mg/100 g). The present results are corroborated with the findings of Mostafa *et al*. (2012) who reported that increasing nitrogen fertigation from 75 to 225 kg/ha increased N (53.265%), P (77.61%), K (25.85%), Ca (14.28%), Zn (16.58%) and Mn (24.75%) uptake in the fruit. Among the combinations, the highest interaction effect was noticed in 15 Aug planting with 30:22:31 kg of NPK/1000 sq m for accumulation of nitrogen (236.10 mg/100 g), phosphorus (41.00 mg/100 g), potassium (346.33 mg/100 g), calcium (19.33 mg/100 g), iron (0.32 mg/100 g) and zinc (0.64 mg/100 g) in bitter gourd fruits (Table 2).

On the basis of present investigation it is concluded that Pusa Rasdar bitter gourd responded well in terms of yield and quality characters with different dates of planting and NPK nutrient level under polyhouse condition. The result indicated that the crop sown on 15 August with higher dose of NPK (30:22:31 kg/1000 sq m) showed significantly better performance for all yield attributes and fruit quality parameters and hence deserves being the most promising treatment for bitter gourd cultivation under polyhouse cum protected condition (Table 2).

SUMMARY

An experiment was conducted to assess the effect of different planting time, viz. 15 August, 1 September and 15 September and NPK fertilizer doses, viz. @15:7:16, 20:12:21, 25:17:26 and 30:22:31 kg/ 1000 sq m on bitter gourd (var.Pusa Rasdar) with the help of hand cum honey bees pollination under protected condition. The results revealed that the yield attributing traits and fruit nutrients accumulation were significantly influenced by different planting time and level of NPK nutrients. Among dates of planting, 15 August exhibited significant higher values for number of fruits/plant (8.57), fruit diameter (5.96 cm), fruit weight (210.60 g), yield/plant (1.81kg), yield/1000 sqm (72.55 q), accumulation of nitrogen (155.09 mg/100 g), phosphorus (36.58 mg/100 g), potassium (329.17 mg/100 g) , besides accumulation of calcium (14.92 mg/100 g), iron (0.26 mg/100 g) and zinc (0.58 mg/100 g) were found more by content but showing no significant difference statistically in fruits over different planting times. On other hand by the higher dose of NPK @30:22:31 kg/1000 sq m results were found statistically significantly higher values for fruit weight (224.05 g), yield/plant (1.88kg), yield/1000 sq m (75.34 q), nitrogen (231.14 mg/100 g), phosphorus (39.33 mg/100 g), potassium (343.56 mg/100 g), calcium (19.33 mg/100 g), iron (0.31 mg/100 g), but zinc (0.59 mg/100 g) content was found more but sown statistically non significant deference as compared to lower dose of fertilizers. Among the interactions, 15 August planting with NPK dose @ 30:22:31 kg/1000 sq m resulted in significant effects on better yield and its attributes. However, accumulation of nutrients, viz. N, P, K, Ca, Fe and Zn, though recorded higher in this variety of bitter gourd but statistically showed a non-significant difference. The result indicated that the crop sown on 15 August with higher dose of NPK (30:22:31 kg/1000 sq m) deserves being the most promising treatment for bitter gourd cultivation under polyhouse cum protected condition.

REFERENCES

Behera T K and Stoub J E. 2007. Bitter gourd and human health. *Medicinal and Aromatic Plant Science*. **1** : 224–6.

Bose T K, Som M G and Kabir J. 1993. *Vegetable Crops*. Naya Prokash, Calcutta.

Chapman H D and Pratt P F. 1961. *Methods of Analysis for Soils, Plants, and Waters*, p 309. Division of Agriculture Sciences, University of California, Berkeley CA.

Edward A H. 1999. Elemental determination by atomic absorption spectrophotometry. (*In*) *Handbook of Reference Method for Plant Analysis,* pp 157–64 Yash P Kalra (Ed.). Soil and Plant Analysis Council, Inc.

Hossain M M. 2001. Influence of planting time on the extension of picking period of four tomato varieties. M Sc thesis, Dept. of Hort., BAU, Mymen Singh, p 46.

Jackson M L. 1962. *Soil Chemical Analysis*. 521 p. Prentice Hall of India, New Delhi.

Knudsen D G A, Peterson G A and Pratt P F. 1982. Lithium, Sodium, and Potassium. *(In***)** *Methods of Soil Analysis (Part 2), Chemical and Microbiological properties,* pp 225–46 Page A L, Miller R H and keeney D R (Eds). ASA-SSSA, Madison, WI, USA.

Mostafa H and Mohammad M M. 2012. Effect of rate and time of nitrogen application on fruit yield and accumulation of nutrient elements in *Momordica charantia*. *Journal of the Saudi Society of Agricultural Sciences.* **11** : 129–33.

Singh A, Jain P K, Sharma H L and Singh Y. 2015. Effect of planting date and integrated nutrient management on production potential of tomato under polyhouse. *Journal Crop and Weed* **11** : 28–33.

Thriveni V, Mishra H N, Pattanayak S K, Sahoo G S and Thomson T. 2015. Effect of inorganic, organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd, *Momordica charantia* L. *International Journal of Farm Sciences* **5**(1) : 24–9.