Int.J.Curr.Microbiol.App.Sci (2018) *7*(8): 2632-2638

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 08 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.708.271

Economic Analysis of Hybrid and Conventional Varieties of Bottle Gourd as Affected by Different Levels of Nitrogen and Plant Spacing

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Keywords

Economics, Nitrogen levels, Plant spacing, Hybrid, Conventional variety

Article Info

Accepted:
15 July 2018
Available Online:
10 August 2018

A B S T R A C T

A field experiment was conducted on bottle gourd at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar. The experiment was laid out in split plot design keeping plant spacing and nitrogen in main plots and varieties in sub-plots comprising 16 treatment combinations viz., two plant spacing, i.e., 60cm (P_1) and 75cm (P_2), four nitrogen levels, i.e., 50 kg/ha (N_1), 62.5 kg/ha (N_2), 75 kg/ha (N_3) and 87.5 kg/ha (N_4) and two cultivars, i.e., GH-22 (V_1) and HBGH-35 (V_2). The significantly highest total fruit yield (378.0 q/h) was obtained in treatment T_{15} sown at 60cm spacing received 87.5 kg nitrogen/ha over total fruit yield of treatment T_{13} (360.5 q/h). The highest net returns (Rs.1,27,227/ha) was obtained from hybrid in treatment T_{15} which was 5.3% more over highest net returns (Rs.1,20,502/ha) of conventional variety in treatment T_{13}. Hence, from the findings, recommendation of treatment T_{15} (N4V2P1) is done as it was most productive as well as economically viable.

Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] also called white-flowered gourd or calabash gourd, running or climbing vine of the gourd family (cucurbitaceous), native to tropical Africa but cultivated in warm climates around the world for its ornamental and useful hard-shelled fruits. It is grown extensively during spring-summer and rainy season in North India. The leading bottle gourd growing states are Utter Pradesh, Punjab, Haryana, Gujarat, Assam, Meghalaya and Rajasthan. In India, Bottle gourd occupied an area of 158000 ha with a production of 2677000 MT (Anonymous, 2017-2018). In Haryana, Bottle gourd occupied an area of 24329 ha with a production of 281893 MT (Anonymous, 2017-2018). The young fruits are edible and are usually cooked as a vegetable. The mature gourds are made into water bottles, dippers, spoons, pipes, and many other utensils and

containers; they can also be fashioned into birdhouses, fancy ornaments, lamps, and musical instruments. Additionally, the vine's showy white flowers and dense foliage make it a popular screen and ornamental plant.

Bottle gourdvines are quick-growing annuals with hairy stems, long forked tendrils, and a musky odour. Many forms of the bottle gourd have been cultivated for specific purposes, and the sizes of the vines, leaves, and flowers, as well as the sizes and shapes of the fruits, vary greatly. The forms are named for the shape of the fruit, e.g., club, dipper, dolphin, kettle, and trough. The fruits of some cultivated varieties may be more than 1 meter (about 3 feet) long. The plants may be grown easily from seed but require a long hot growing season to mature.

It is the modest source of nutrients (Sheshadri, 1986) yet it is popular only among a large section of population. The mature and tender fruits are consumed as boiled and fried vegetable. It provides cooling effect and prevents constipation. Its leaf juice is useful for curing children diarrhea. Leaves in the form of decoction with sugar are used for jaundice. The seed oil forms an emollient application for the head to relieve headache. The pulp from the cultivated form is used occasionally as purgative and antidote to certain poisons and is also useful in coughs. Using proper spacing and nitrogen increased the yield of bottle gourd (Shukla and Prabhakar, 1987; Jadhav *et al.,* 1996 and Patil *et al.,* 1996). Much progress has been made in the development of high yielding varieties and hybrids over the past two decades. The assessment of input like spacing and fertilizers for newly developed bottle gourd varieties is very important. Considering the above aspects in view, the present experiment was conducted to make spacing and nitrogen recommendation of newly developed bottle gourd varieties, along with this, to find out which one gave more Net returns (Rs./ha) with the help of economic analysis.

Materials and Methods

A field experiment was conducted on bottle gourd at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar. Hisar is situated at 29º10' latitude North and 75º46' longitude East at an altitude of 215.2 meters above mean sea level. The climate of Hisar is semi-arid with hot dry winds during the summer months, warm humid in monsoon and dry cold in winter. The mean maximum and minimum temperature show a wide range during the year. Most of rainfall is received during the months of July to September. The meteorological data (monthly averages) for the crop growing season collected from the Department of Agricultural Meteorology of the University.

The field selected for the study was uniform. A composite soil sample from 0-30 cm soil depth was taken randomly from ten places from the field before layout of the experiment. The samples were mixed thoroughly, dried and were subjected to mechanical and chemical analysis. Soil analysis revealed that the soil of the experimental field was sandy loam in texture, non-saline, medium in organic carbon content, low in available nitrogen high in available phosphorus and rich in potassium content.

The experiment was laid out in split plot design keeping plant spacing and nitrogen in main plots and varieties in sub-plots comprising 16 treatment combinations viz., two plant spacing, i.e., 60cm (P_1) and 75cm (P_2), four nitrogen levels, i.e., 50 kg/ha(N_1), 62.5 kg/ha (N_2), 75 kg/ha (N_3) and 87.5 kg/ha (N_4) and two cultivars, i.e., GH-22 (V_1) and HBGH-35 (V_2).

The treatments were laid out in split plot design with three replications. The plant spacing and nitrogen levels were kept in main plots and varieties in sub-plots. The crop was

raised on 3 m length, 2.5 m width and 15 cm high raised beds. A heavy bund was made as a buffer between two beds in order to avoid the movement of nitrogen. Two seeds hill^{-1} were sown on one side of the raised bed, and later, one healthy seedling hill^{-1} was retained. Full dose of phosphorus and potash @ 25 kg/ha (recommended dose) along with half dose of nitrogen was applied as basal application at the time of sowing and the remaining half of nitrogen was applied in two splits one month after sowing and at flowering stage. All the recommended package of practices were followed during the course of experimentation to raise a healthy crop.

The approximate total cost and net returns per hectare were calculated from the crop as per recommended package (50 kg nitrogen /ha and 60 cm plant spacing), and over it the net returns from the various treatments was calculated. The cost of cultivation was calculated by considering the prevailing rates of inputs in the university/market and official labour rates in the district. Gross return was calculated by taking the average of market committee rates of bottle gourd fruits that prevailed during the period of investigation.

Results and Discussion

Total fruit yield (q/ha) was significantly influenced owing to all the three factors, *i.e*, nitrogen, plant spacing and varieties. The total fruit yield was higher with the lower plant spacing (60cm) than increased plant spacing (75cm), due to lower plant spacing produce more plants in an area so got more no. of fruit. The total fruit yield was higher over the lower levels with each increasing level of nitrogen. The maximum total fruit yield with 60 cm plant spacing and variety GH-22 was obtained with the application of nitrogen 87.5 kg/ha(360.5 q /ha) whereas, minimum was obtained with recommended dose *i.e.*, 50 kg nitrogen/ha (324.6 q /ha) and the highest dose of nitrogen increased total yield by 9.8% over the recommended dose. In case of Hybrid HBGH-35, maximum total fruit yield with 60 cm plant spacing was obtained with the application of nitrogen 87.5 kg/ha (378.0 q/ha) whereas, minimum was obtained with recommended dose *i.e.*, 50 kg nitrogen/ha (336.3 q/ha) and the highest dose of nitrogen increased total yield by 11% over the recommended dose. Treatment T_{15} produced 4.6% significantly more yield (378.0 q/ha) as compared to the Treatment T_{13} (360.5 q/ha).These results are in agreement with Suresh and Pappiah (1991) in bitter gourd, Patil *et al.*, (1996), Darajan *et al.*, (2000), Leghari *et al.*, (2014), Siva *et al.*, (2017), Meena and Bhati (2017) and Meena *et al.*, (2017) in bottle gourd.

Economics of various treatment of the present investigation was calculated and has been presented in table-2. The highest net return from nitrogen dose of 50 kg/ha (N_1) was obtained as Rs. 1,04,684/ha. Similarly the treatment with nitrogen dose of 62.5 kg/ha (N_2) and 75 kg/ha (N_3) resulted maximum net returns of Rs. 1,14,505, Rs. 1,17,621/ha and 1,27,227/ha which were 9.38%, 12.36% and 17.7% higher over the net returns of recommended dose, respectively.

However the overall results indicated that the treatment with nitrogen dose of 87.5 kg/ha (N_4) along with plant spacing of 60 cm (P_1) in case of hybrid HBGH-35 (V_2) resulted the highest net returns of Rs. 1,27,227/ha. This treatment T_{15} ($N_4V_2P_1$) fetched Rs. 22,543/ha, with 21.53% increase in net returns over the T_3. Similarly, the treatment with nitrogen dose of 87.5kg/ha (N_4) along with plant spacing 60cm (P_1) in variety GH-22 (V_1) was the second best treatment ($N_4V_1P_1$), Resulting The Net Return of Rs. 1,20,502/ha and fetched Rs. 19,353/ha more which showed 19.13% increase in net returns over the recommended package.

Table.1 Detail of the experimental treatments

Treatments	Details	Nitrogen (kg/ha)	Cultivar	Plant Spacing (cm)
T_1	N1V1P1	50	GH-22	60
T_2	N1V1P2	50	GH-22	75
T_3	N1V2P1	50	HBGH-35	60
T_4	N1V2P2	50	HBGH-35	75
T_5	N2V1P1	62.5	GH-22	60
T_6	N2V1P2	62.5	GH-22	75
T_7	N2V2P1	62.5	HBGH-35	60
T_8	N2V2P2	62.5	HBGH-35	75
T_9	N3V1P1	75	GH-22	60
T_{10}	N3V1P2	75	GH-22	75
T_{11}	N3V2P1	75	HBGH-35	60
T_{12}	N3V2P2	75	HBGH-35	75
T_{13}	N4V1P1	87.5	GH-22	60
T_{14}	N4V1P2	87.5	GH-22	75
T_{15}	N4V2P1	87.5	HBGH-35	60
T_{16}	N4V2P2	87.5	HBGH-35	75

Table.2 Economics of various treatments in the bottle gourd

Treatment	Details	Total cost Rs.	Production (q/ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Increase in net return over best Treatment (Rs.)	% Increase in net return over best treatment	
							Conv.	Hybrid
T_1	N1V1P1	2016	324.6	1,78,530	1,01,149	-	-_	-
T_2	N1V1P2	1716	319.1	1,75,505	98,424	-2725	-2.69	-
T_3	N1V2P1	4516	336.3	1,84,965	1,04,648	-	-	-
T_4	N1V2P2	3716	324.6	1,78,530	99,094	-5635	-	-5.38
T_5	N2V1P1	2150	330.7	1,81,885	1,04,370	3221	3.18	-
T_6	N2V1P2	1850	324.8	1,78,640	1,01,425	276	0.29	-
T_7	N2V2P1	4650	354.4	1,94,920	1,14,505	9821	-	9.38
T_8	N2V2P2	3850	342.3	1,88,265	1,08,650	3966	-	3.97
T_9	N3V1P1	2279	342.5	1,88,375	1,10,731	9582	9.47	-
T_{10}	N3V1P2	1979	337.9	1,85,845	1,08,501	7352	7.27	-
T_{11}	N3V2P1	4779	360.3	1,98,165	1,17,621	12937	-	12.36
T_{12}	N3V2P2	3979	354.6	1,95,030	1,15,286	10602	-	10.13
T_{13}	N4V1P1	2408	360.5	1,98,275	1,20,502	19353	19.13	-
T_{14}	N4V1P2	2108	348.4	1,91,620	1,14,147	12998	12.85	-
T_{15}	N4V2P1	4808	378.0*	2,07,900	1,27,227	22543	-	21.53
T_{16}	N4V2P2	4108	366.5	2,01,575	1,21,702	17018	-	16.26

* Significantly over rest of the others treatments

Table.3 Approximate cost of cultivation (Rs/ha) of bottle gourd as package of practices

Sr. No.	Items	Variety (Rs.)	Hybrid (Rs.)
1	Land preparation (2 ploughings @ Rs. 370/hour or Rs. 185/acre)	925	925
2	Cost of manure & fertilizers		
	a. FYM :150q/ha, (15 trollies @ Rs.450/trolly)	6750	6750
	b. Urea : 108 kg/ha(@ Rs.239/50 kg bag or Rs.4.78/kg)	516	516
	c. SSP :156 kg/ha (@Rs.200/50 kg bag or Rs 4.0/kg)	624	624
	d. MOP :42 kg/ha(@ Rs.222/50 kg bag or Rs 4.44/kg)	187	187
3	Layout of field (4 DPLs/acre or 10 DPLs/ha @ Rs.135/DPL)	1350	1350
4	Cost of seed a. Variety =5kg/ha (@ Rs.300/kg) b. Hybrid= 2kg/ha (@ Rs.2000/kg)	1500	4000
5	Cost of sowing of seed (5 DPLs/ha (@ Rs.135/DPL)	675	675
6	Irrigation		
	a. Charges (8 irrigations (@ Rs.135/ha)	800	800
	b. Labour 2 DPLs/irrigation (@ Rs.135/DPL)	2160	2160
7	Intercultural operations : 20 DPLs (Rs.135/DPL)	2700	2700
8	Plant protection charges	1000	1000
10	Picking charges : 15 pickings @7 DPLs/picking (@ Rs.135 per DPL)	14175	14175
11	Transportation and marketing charges	7500	7500
12	Miscellaneous	2000	2000
13	Variable cost	43862	46362
14	Risk factor (10% of variable cost)	4387	4637
15	Rent of land : @ Rs.20,000/acre /year or Rs.25,000/ha for 6 months	25000	25000
16	Interest on working capital @ 12.5% per annum	4132	4282
17	Gross expenditure	**77,381**	**80,281**
18	Total yield (q/ha)	324.6	336.3
19	Gross return (Rs/ha)	1,78,530	1,84,965
20	Net returns (Rs./ha)	**1,01,149**	**1,04,684**

The recommended package for nitrogen and plant spacing was 50 kg nitrogen/ha (N_1) and 60cm plant to plant spacing (P_1), thus the treatment with recommended package of practices over which increase in net returns (in terms of rupees and percent) has been calculated for variety and hybrid were $N_1V_IP_1$ and $N_1V_2P_1$, respectively. The highest net returns with recommended package of practice were obtained from treatment T_3 (Rs. 1,04,684/ha) and treatment T_1 (Rs. 101,149 /ha), treatment T_3 gave 3.4% more net returns than treatment T_1. In other hand highest net returns were obtained from treatment T_{15} (hybrid) Rs. 1,27,227/ha and treatment T_{13} (Conventional variety) Rs. 1,20,502/ha, which was 5.3% more net returns, it came when the hybrid better shape and size fruits were sold at the same price with Conventional variety fruits (table 3). Hybrid (HBGH-35) could easily get better prices than conventional variety (GH-22) due to its good size and shape.

Thus, by investing Rs. 392 more in the application of nitrogenous fertilizer (urea), Rs. 22,543 and Rs. 19,352 more could be earned by sowing hybrid and variety with 87.5 kg nitrogen/ha with 60 cm plant spacing, respectively over the recommended package for the cultivars. These results are in agreement with Noonari *et al.*, (2015) in tomato.

In conclusion, the study indicated that under the agro-climatic conditions of Hisar, the optimum growth and the maximum fruit yield of bottle gourd variety GH-22 and hybrid HBGH-35 could be obtained with the application of nitrogen 87.5 kg/ha and 60 cm plant spacing. Hybrid treatment T_{15} ($N_4V_2P_1$) gave 4.6% significantly more yield with 5.3% more Net Return as compare to conventional variety treatment T_{13} ($N_4V_1P_1$) and This benefits got when hybrid better shape and size fruits sold with conventional variety fruit at the same price. A good option came out from the study that higher yield and income encouraged farmer for continuing bottle gourd cultivation.

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How to cite this article:

Mukesh Kumar and Kuldeep Kumar. 2018. Economic Analysis of Hybrid and Conventional Varieties of Bottle Gourd as Affected by Different Levels of Nitrogen and Plant Spacing. *Int.J.Curr.Microbiol.App.Sci.* 7(08): 2632-2638. doi: https://doi.org/10.20546/ijcmas.2018.708.271